

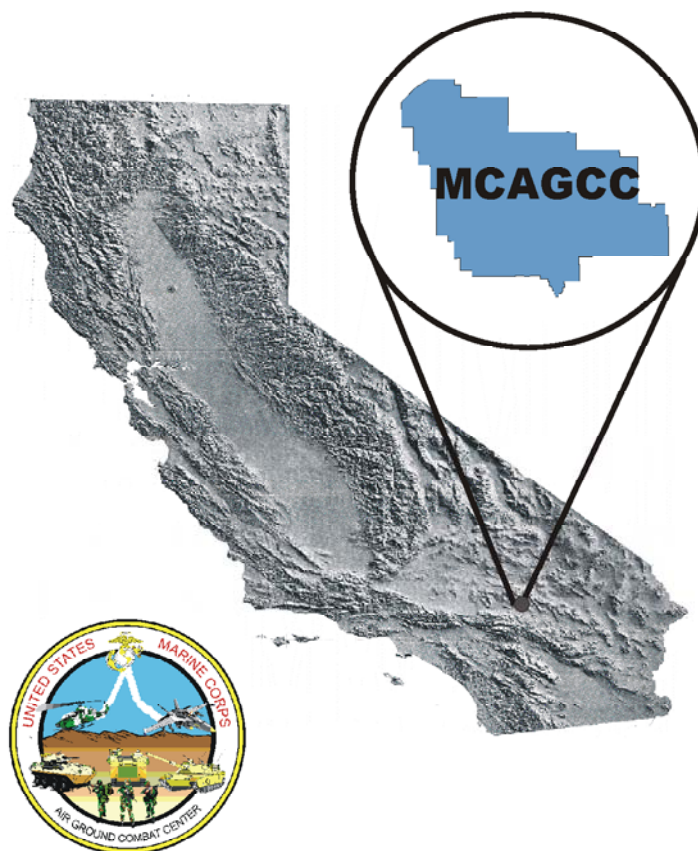


**US Army Corps
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Engineer Research and
Development Center

Marine Corps Air Ground Combat Center (MCAGCC) Land Management System (LMS) Military Field Application Site FY02 In-Progress Review

Heidi R. Howard, Dick Gebhart, and William D. Goran

September 2002



Foreword

This study was conducted for the U.S. Army Corps of Engineers Research and Development Directorate, which established the Land Management System (LMS) Special Project Office in March 1997. The work was done under 622720A917, Congressional funding. The proponents are Dr. Lewis E. Link, Director of Research and Development for the U.S. Army Corps of Engineers (CERD-Z), and Dr. Donald Leverenz, Deputy Director of CERD.

The work was performed by the Land and Heritage Conservation Branch (CN-C) and Ecological Processes Branch (CN-N) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Dick Gebhart and the Assistant Investigator was Heidi Howard. The technical editor was Gloria J. Wienke, Information Technology Laboratory. Lucy A. Whalley is Chief, CEERD-CN-C, Stephen E. Hodapp is Chief, CEERD-CN-N and Dr. John T. Bandy is Chief, CEERD-CN. The associated Technical Director was Dr. William D. Severinghaus, CEERD-TD. The Director of CERL is Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL John Morris III, EN and the Director of ERDC is Dr. James R. Houston.

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1 Introduction

Background

The Land Management System

The Land Management System (LMS) is an initiative of the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) focused on improving landscape analysis and landscape management capabilities in several of the Corps of Engineers major mission areas. These mission areas include the U.S. Army Civil Works Programs (navigation, flood control, water supply and quality, recreation, etc.), military installations operations and management (specifically military land management), and military engineering and terrain related operations (trafficability analysis, military hydrology, littoral operations, line of sight analysis, etc.).

The purpose of LMS is to provide relevant science, tools, and information to land and water resource managers and decisionmakers with the goal of enhancing their ability to understand and communicate past, current, and potential impacts of management actions on land and water resources. LMS was established, in part, to improve synergism in technology development across each of these mission areas, to improve USACE's and the Department of Defense's (DoD's) ability to represent landscape processes and features, and forecast future landscape conditions, based upon alternative scenarios.

The LMS initiative had its roots in a study initiated in autumn 1995 related to modeling and simulation capabilities developed or used by the Corps of Engineers, related to landscapes and geoprocesses. After this study, the Director of Research and Development, in consultation with the USACE laboratory directors and others, decided to establish the LMS initiative.

To accomplish the goals of LMS, a Special Project Office for LMS was established, with representatives from most of the ERDC Laboratories, the Hydrologic Engineering Center of the Water Resources Support Center, and several Corps of Engineer Districts. The project director, associate directors, and the various organizational representatives comprise the LMS Development Team. Researchers throughout the ERDC laboratories (and their partners) form work teams to

perform specific tasks associated with LMS; these efforts are dovetailed into numerous existing technology programs.

Plans for the LMS Initiative are available (and updated) on the LMS website (<http://www.denix.osd.mil/LMS>) under the Defense Environmental Network Information eXchange (DENIX). For more information please see the ERDC/CERL Technical Report 99/60, *Plans for the Land Management System (LMS) Initiative* on the LMS website.

The LMS Field Application Program

The LMS Field Application Program has four major purposes:

1. To provide problem-solving and partnering relations between the Corps of Engineers scientists, technology developers, and interested and innovative landscape/natural resource managers in USACE's major mission areas.
2. To provide site-specific and problem-specific input into the design of land management functional capabilities.
3. To provide technology test environments where scientists, technology developers, and resource managers/analysts together can tackle issues, test solutions, adjust approaches, capture costs and benefits, and "demonstrate" the results to interested parties.
4. To provide a framework for planning the transfer of LMS technology to land/water resource managers, both at the sites for demonstrations and other similar sites.

Field application sites were selected based on the following criteria:

1. Interest from land/water resource managers in infusing new capabilities into their business practices, and developing collaborative partnerships with scientists and technology providers.
2. Representative land/water resources management issues — such as high levels of use, sensitive resources, competing multiple uses and stakeholders, and other problems and issues identified by user groups as important.
3. Importance of the site or problem set to the mission.
4. Support and concurrence for LMS Field Applications not only at the local level, but also from across the organizational management.
5. Synergism with existing programs/efforts.

The original sites selected for field applications were Fort Hood, TX, and three locations in the Upper Mississippi River Basin: (1) Redwood Basin, along the Minnesota River in Southern Minnesota, (2) Pool 8 on the Mississippi River near LaCrosse, WI, and (3) Peoria Lakes, on the Illinois River at Peoria, IL. In 1999, the Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms,

CA, was officially designated as a field application site. In 2001, Fort Benning, GA, was also designated as a field application site and in 2002, Holloman Air Force Base, NM, was added as another field site.

There is a Field Application Site Coordinator for each site. Dr. Dick Gebhart serves in this capacity for the MCAGCC site. MCAGCC's user point of contact (POC) is Mr. Kip Otis-Diehl from the Natural Resources and Environmental Affairs Directorate at MCAGCC.

The MCAGCC Military Field Application Site

MCAGCC is composed of 596,480 acres (932 square miles [2414 sq km]) within the heart of the Mojave Desert, 40 miles (64 km) north of Palm Springs, CA. It was established in 1952. The desert terrain and arid climate offer prime training conditions to carry out MCAGCC's mission. The primary mission is to develop, administer, and evaluate the Marine Corps' Combined Arms Exercise (CAX) training. Annually, 50,000 to 60,000 soldiers are processed through the CAX program. An additional 8,000 Marines are trained in electronic fundamentals, operational communications, air control/anti-air warfare operations, and communication/electronic maintenance at the Marine Corps Communication-Electronics School (MCESS) at MCAGCC.

The topography and climate at MCAGCC present unique natural resource management issues. The fragile desert ecosystem is highly susceptible to impacts that in most areas are normally insignificant. The repair of these impacts through natural processes may take thousands of years. Land managers are responsible for ensuring the sustainable usefulness of training areas by minimizing impacts on plant communities, soils, water, and animal communities, and through monitoring of training impacts. Land managers need accessible tools for monitoring and predicting these impacts. Monitoring and predicting impacts on training lands will ensure safe and effective training lands for both troops and the Mojave Desert ecosystem.

LMS Field Application Program Transitions

The field application program for LMS both shapes the development of new LMS capabilities and tests these capabilities to help solve management and landscape analysis problems in the field. The field application efforts provide opportunities to test, evaluate, modify, and document how LMS capabilities help to address specific user problems and how LMS results and capabilities fit into decision processes at user sites.

Field Application Site In-Progress Reviews (IPRs) are designed to ensure that the stages of evaluation, modification, and documentation are fulfilled. These reviews also allow other interested parties to look over the shoulders of those involved at the host site and evaluate the value of applying LMS investments and results at other sites.

Preliminary contact with MCAGCC was initiated in September of 1998, followed by a letter of invitation to serve as a field application site in January of 1999. The initial LMS Needs Assessment workshop was held at MCAGCC during February of 1999 to identify and prioritize land/water resource management issues at the site. A plan was then developed and projects initiated to address these plans. This report documents the second IPR, user recommendations, and post-IPR follow-up actions.

Objectives

The objectives of this IPR were to provide a forum where personnel involved with specific MCAGCC Land Management System Military Field Application projects could discuss the progress of each effort, identify the relationships between projects, and solicit input from potential users of the resulting products.

Approach

The IPR workshop was held 21 February 2002, at the Holiday Inn - Palm Mountain Resort in Palm Springs, CA. The IPR consisted of presentations on LMS and individual projects. Following project presentations, inputs from installation personnel and others present were obtained. Prior to the meeting closure, user input was discussed and actions were defined to address each issue. Results of the IPR are documented in this report to ensure project improvements and adjustments occur and to assist with the next IPR.

Scope

The MCAGCC LMS Military Field Application IPR addresses only projects associated with the MCAGCC LMS Military Field Application. This report does not attempt to address projects and issues associated with other military and civil works LMS field applications.

Mode of Technology Transfer

This report documents the presentations and discussions of the MCAGCC LMS Military Field Application IPR. Technical concerns and unresolved issues associated with individual projects are being addressed by the project investigators on an individual project basis.

This report will be made accessible through the World Wide Web (WWW) at URL:

<http://www.cecer.army.mil>

2 Agenda for the FY02 MCAGCC LMS Military Field Application Site IPR

The agenda for the MCAGCC LMS Military Demonstration FY02 IPR is provided below.

Thursday, 21 February 2002

- | | |
|-------------|---|
| 8:00-8:30 | IPR Opens at Holiday Inn Palm Mountain Resort |
| 8:30-9:00 | Overview LMS Introduction: Mr. Bill Goran |
| 9:00-09:30 | MCAGCC Introduction: Dr. Dick Gebhart |
| | Inter-connection of projects and user requirements |
| 09:30-10:30 | Wind Erosion: Dr. Ed Skidmore |
| 10:30-10:45 | Break |
| 10:45-11:45 | Ecological Dynamics Modeling: Dr. Jeff Fehmi |
| 11:45-13:00 | Lunch Break |
| 13:00-13:45 | Catastrophic Erosion Events and Nutrient Dynamics:
Dr. Chris Baldwin |
| 13:45-14:30 | Change Detection / Remote Sensing at MCAGCC:
Dr. Tom Frank & Mr. Scott Tweddale |
| 14:30-15:00 | Research Directions @ the National Training Center Fort Irwin,
CA: Ms. Ruth Sparks |
| 15:00-15:30 | Break |
| 15:30-16:15 | Comment and Review <ul style="list-style-type: none">▪ Feedback from MCAGCC POCs▪ General direction on MCAGCC Military Demonstration |
| 16:15-16:30 | Closing remarks, IPR conclusion. |

3 MCAGCC LMS Military Field Application Site IPR Attendees

The following individuals attended the FY02 MCAGCC LMS Military Field Application Site IPR.

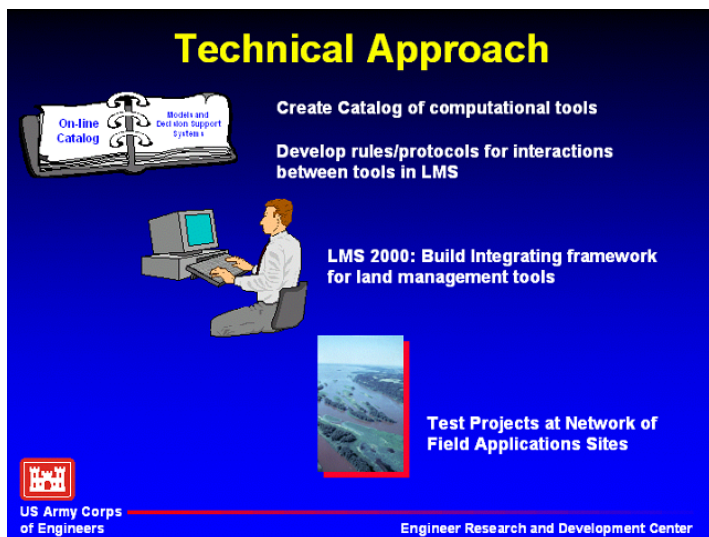
NAME	ORGANIZATION
Christopher Baldwin	Sam Houston State University
Kevin Bartsch	UT ARNG
Marie Cottrell	MCAGCC
Rhys Evans	MCAGCC
Tom Frank	University of Illinois
Dick Gebhart	ERDC/CERL
Bill Goran	ERDC/CERL
Trish Griffin	Naval Facilities Eng.
Heidi Howard	ERDC/CERL
Randy Karalus	ERDC/TEC
Dave Mouat	Desert Research Institute
Kip Otis-Diehl	MCAGCC
Rob Palmer	Naval Facilities Eng.
Doug Ramsey	Utah State University
Richard Rush	Sam Houston State University
Ed Skidmore	U.S. Department of Agriculture - Agriculture Research Service
Ruth Sparks	Fort Irwin
Paul Tueller	University of Nevada Reno
Scott Tweddale	ERDC/CERL
Robert Washington-Allen	Oakridge National Laboratories
T. J. Williams	MCAGCC

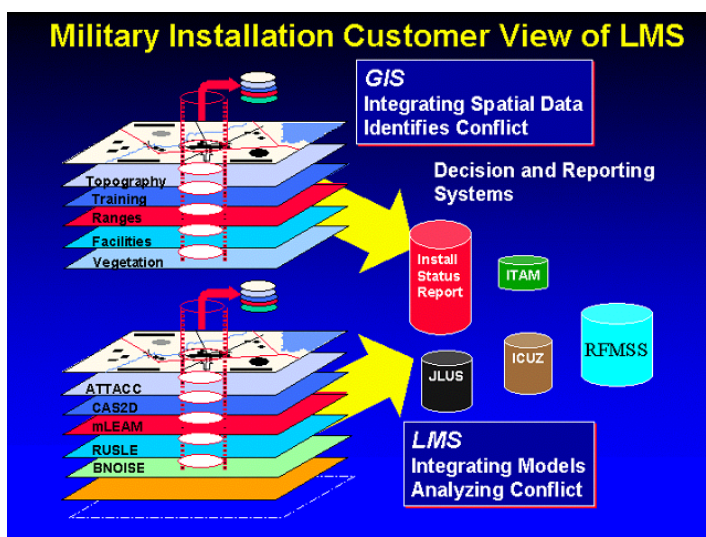
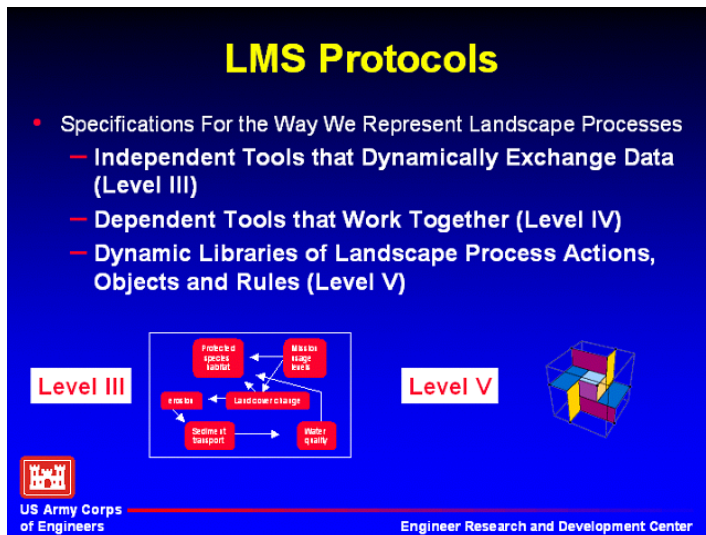
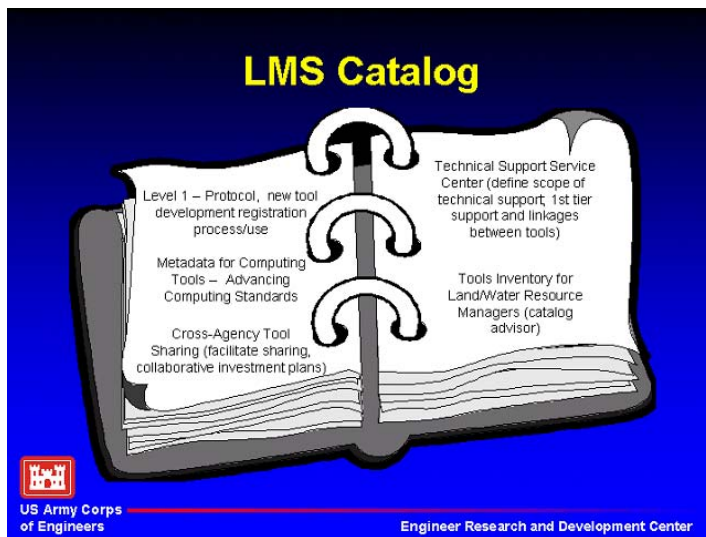
4 MCAGCC LMS Military Field Application Site IPR Project Presentations

The following pages provide briefing materials presented at the MCAGCC LMS Military Field Application Site IPR. Each section provides the presenter's name and the presentation materials.

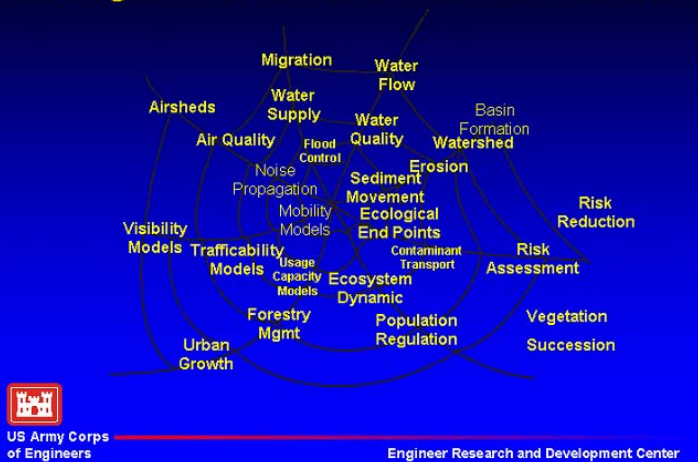
PRESENTATION: The Land Management System.

PRESENTER: Mr. William Goran.





Linkages Across Environmental Processes



LMS Field Application Sites



LMS Military Field Application Sites

- Ft. Hood, TX
- Marine Corps Air Ground Combat Center, CA
- Ft. Benning, GA
- Holloman Air Force Base, NM

Ft. Hood Field Application Site Projects

- Habitat Tradeoff Analysis
 - Web-Based Mapping
 - EDYS Analysis/Testing
 - Vegetation Mapping Protocols and Test
 - Stream-Stage Soil Moisture Condition Assessment
 - Enterprise GIS for Military Lands
 - Enhancements to ATTACC
 - Uncertainty and Error
- 1998-2000
 - 1998-2000
 - 1998-2000
 - 1998-2001
 - 1998-2002
 - 2000-2003
 - 1997-2001
 - 1997-2001



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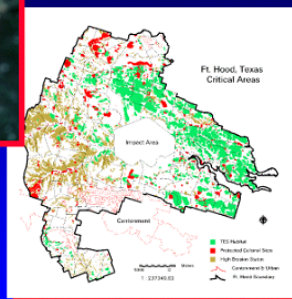
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Habitat Tradeoff Analysis

Researchers: Shapiro & Westervelt



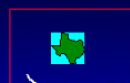
Black-Capped Vireo



Training Requirements for
Two Divisions

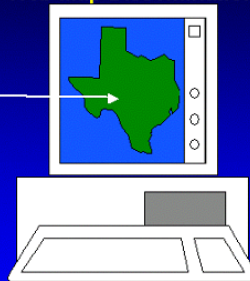
Web Mapping

Researcher: Kelly Dilks



Network
linkages to
State, Local
and National
Repositories

Web Map Dissemination



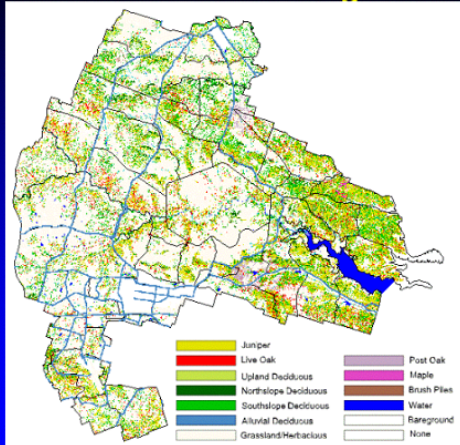
Web Service to Users
Across Installation



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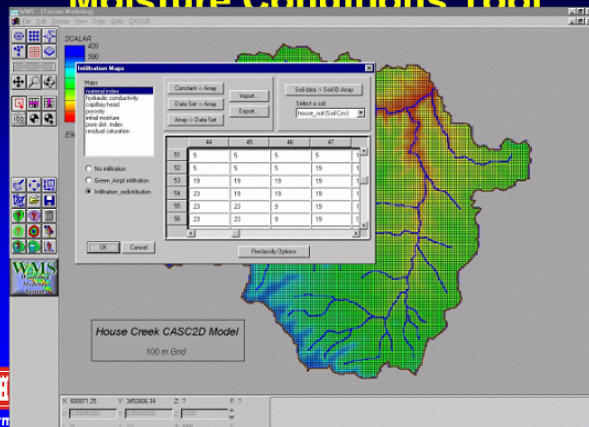
Loechl: Fort Hood Vegetation



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Martin: Stream Stage Soil Moisture Conditions Tool

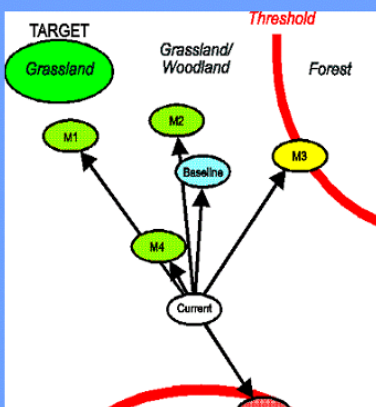


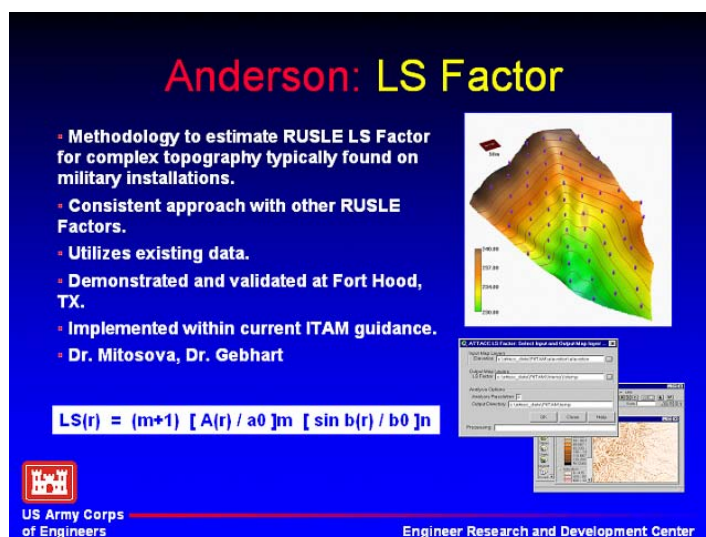
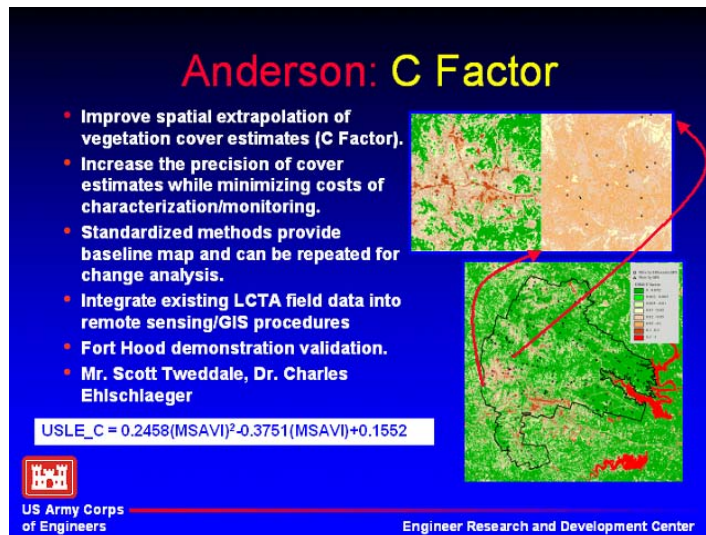
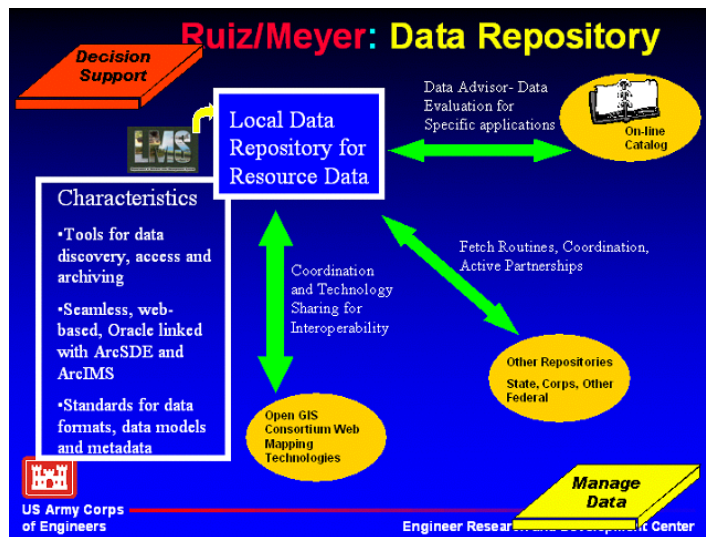
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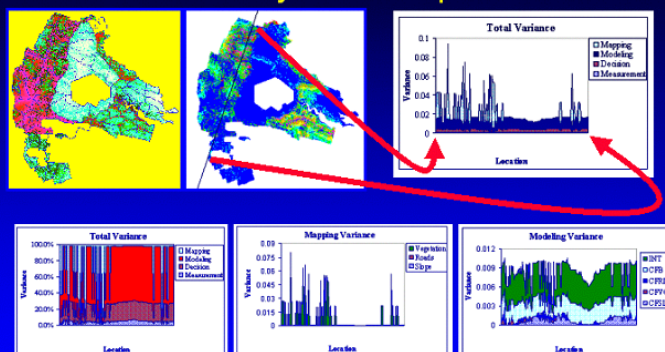
Price: Ecological Dynamics Simulation (EDYS) Model Demonstration/Validation

- Management and Restoration Strategies
 - ID Ecological risks or risks to mission
 - ID management or restoration strategies?
 - Run simulations to bound likely outcomes
 - Prioritize management actions and thresholds





Gertner and Anderson: Uncertainty Analysis Example



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Ft. Benning Field Application Site – Projects

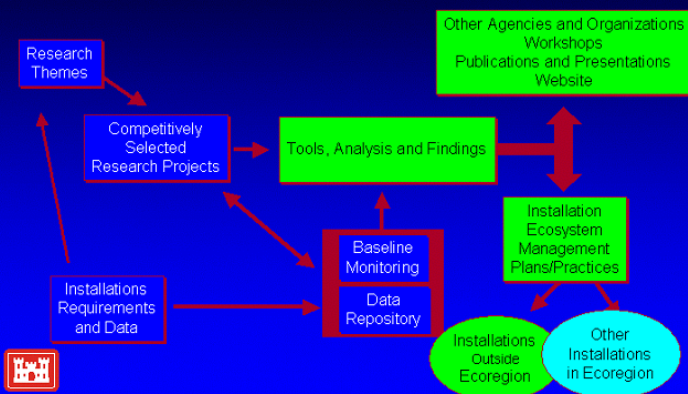
SERDP Ecosystem Management Project (SEMP)	Hal Balbach, et. Al	1998-2010
Urban Dynamics Impacting the Installation	Brian Deal and Dr. Peter Luttersmidt, TRIES	2000-2002
Dynamic Planning Documents – INMRP and CRMRP	Kelly Dilks, Douglas Johnston, Diane Timlin, UI	2001-2002
TES Habitat Impacts from Forestry Mgmt	Chris Rewerts, USDA, Argonne National Lab	2002-2004



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Balbach: SEMP Technical Approach

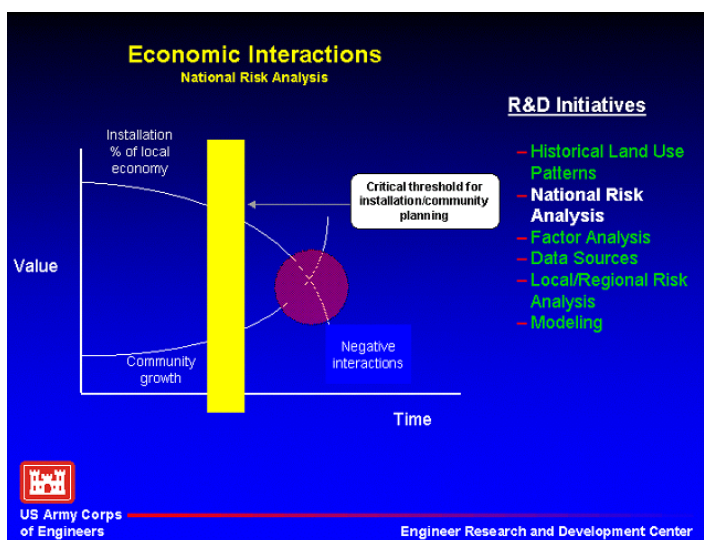
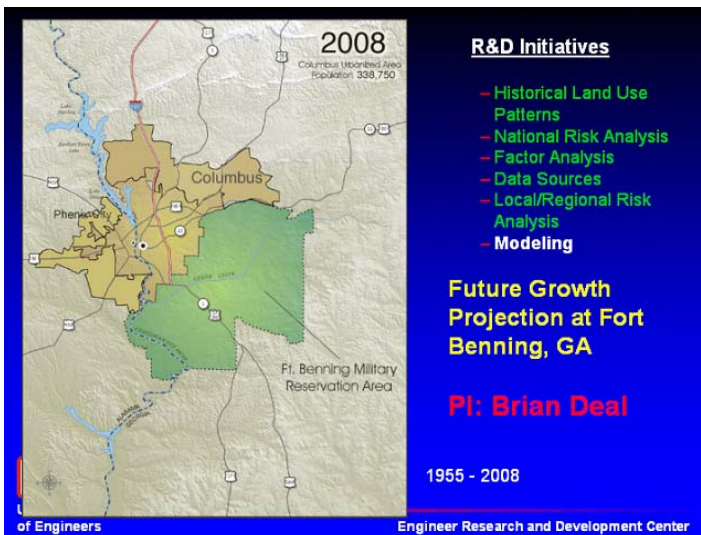
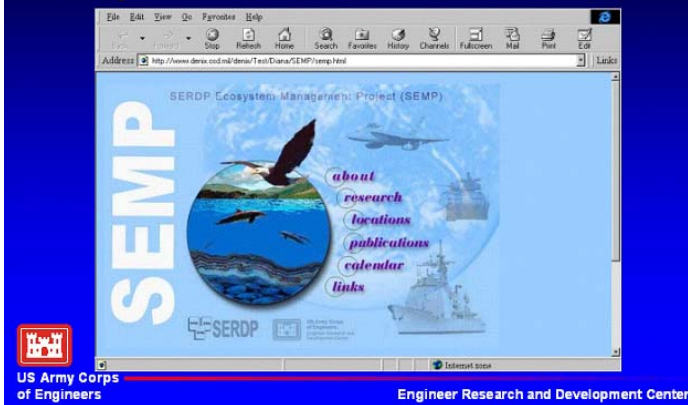


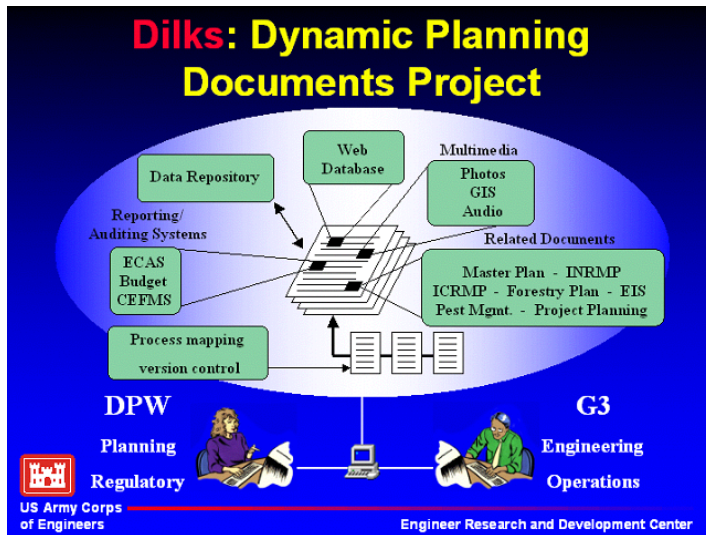
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SEMP Website

<http://www.denix.osd.mil/SEMP>





Forest Growth and Protected Species Habitat Dynamics

- **Researchers:** Chris Rewerts
- **Planned Start:** 2003
- **Partners:** Ft. Benning Forestry and Natural Resources Branches, Argonne National Lab, USDA Forest Service.
- **Purpose:** Simulate forest growth under differing mgmt practices in terms of both species habitat and forest growth/disease futures

**Dynamic Linkages:
RCW Populations &
Forest Growth**

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Holloman Air Force Base

- **Project Start** 2002
- **Installation POC:** Dr. H. Reiser

Topic: Analysis of Risk for Air Flights with Endangered Raptor Release

- **Researcher:** Don Pitts
- **Partners:** Air Force BASH Team, White Sands Missile Range, Flight Safety, TRIES/Sam Houston State University

California Condor in captive breeding program at the Peregrine Fund's World Center.

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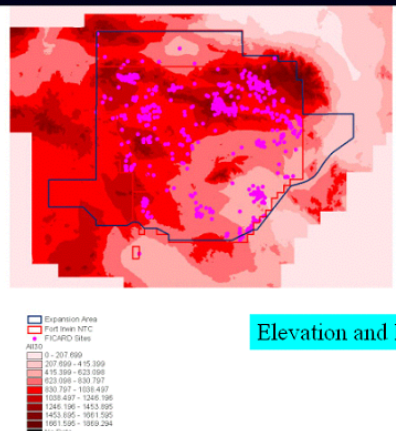
Marine Corps Air Ground Combat Center Projects

- ATTACC Adaptations for MCAGCC
- Wind Erosion
- Ecological Dynamics Modeling
- Catastrophic Erosion Events and Nutrient Dynamics
- Change Detection and Remote Sensing



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Ft. Irwin Archeological
Predictive Modeling

Tad Britt
Researcher

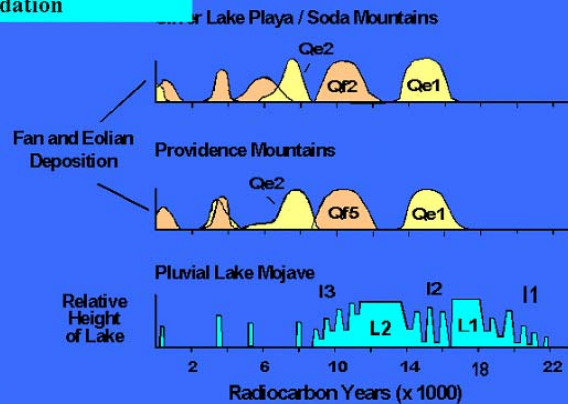
Elevation and Known Sites



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Regional Periods of Alluvial Fan Aggradation



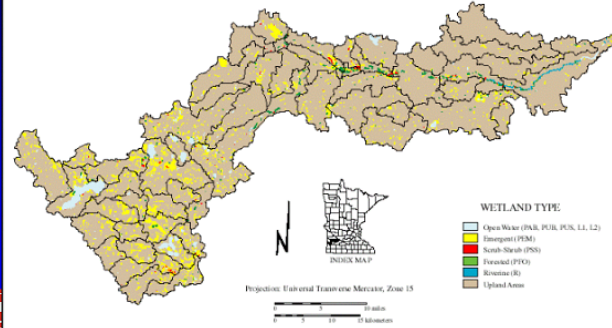
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Upper Mississippi Project

Bill Martin: Researcher

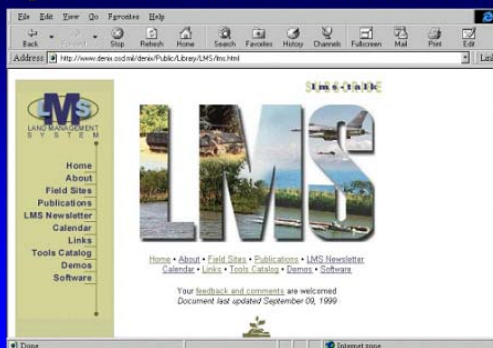
REDWOOD RIVER MAJOR WATERSHED NATIONAL WETLANDS INVENTORY (NWI) GENERAL WETLAND CLASS



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LMS Website (<http://www.denix.osd.mil/LMS>)



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PRESENTATION: MCAGCC LMS Military Field Application Program
Overview.


PRESENTER: Dr. Dick Gebhart.

MCAGCC/LMS Overview

LMS-IPR, 21 February 2002

Partners

- ERDC-CERL
- MCAGCC/USMC/SWDNFEC
 - Kip Otis-Diehl, Rhys Evans, Rob Palmer
- USDA-ARS-WERU
- Oregon State University
- Tierra Data Systems
- USACE/Sacramento District
- SERDP
- Sam Houston State University (TRIES)




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Background/History

- Field Application Site Selection Criteria
 - Interest from natural resources managers in integrating new capabilities and further developing science and technology partnerships
 - Sensitive and highly visible natural resources management problems
 - Importance of site and problems to mission
 - Support across all levels of the field application site and parent organization
 - Synergism with existing programs and efforts



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Background/History

- **MCAGCC Selection Criteria**
 - Keen interest in developing an ITAM program
 - Desert tortoise, wind erosion, vegetation establishment, and mission sustainability are management concerns unique to MCAGCC and other arid military installations
 - Excellent data sets with sophisticated GIS capabilities and personnel
 - Support across all levels of the field application site and parent organization; Commanding General, Installations & Logistics, NREA
 - Recently implemented LCTA program



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LMS Field Application Site-MCAGCC

LMS OBJECTIVE

- Development of capabilities/systems/models for effective training land, habitat, natural resources, and ecosystem management in arid and semiarid regions



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LMS Field Application Site-MCAGCC

Natural Resources Problems/Concerns

- Arid landscapes are particularly sensitive to training disturbances and have long recovery times
- Disturbances from frequent and heavy training activities (CAX) result in:
 - loss of vegetation cover and diversity
 - soil disturbance and increased wind erosion
 - loss of critical habitat (i.e. desert tortoise)
 - invasion of non-native plant species
 - decreased training realism



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LMS Field Application Site-MCAGCC

Natural Resources Problems/Concerns

- Methods to characterize training capacity, design/adjust training use, and forecast future land conditions based on alternative training scenarios are needed to improve sustainability
- Wind erosion as affected by substrate type, training intensity, and training frequency
- Catastrophic erosion events



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LMS Field Application Site-MCAGCC

SPECIFIC PROJECTS

- Land Based Carrying Capacity
 - Integration of LCTA data into modeling and simulation scenarios for land use compatibility and carrying capacity analysis
 - Ecological Dynamics Simulation Model (EDYS)
 - Integration of wind erosion component into Army Training and Testing Area Carrying Capacity (ATTACC) model



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LMS Field Application Site-MCAGCC

SPECIFIC PROJECTS

- Land Rehabilitation and Maintenance
 - Wind/Water Erosion
 - Characterization of sediment genesis, transport, and deposition via wind and water erosion processes
 - Identification of sources, conduits, and sinks under average, rare event (catastrophic), and combined conditions
 - Relationships to training activities



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LMS Field Application Site-MCAGCC

SPECIFIC PROJECTS

- Land Rehabilitation and Maintenance
 - Wind/Water Erosion
 - Examination of nutrient flux from rare event versus climatic average wind/water erosional processes



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LMS Field Application Site-MCAGCC

RELATED PROJECTS

- SERDP
 - Analysis and Assessment of Military and Non-Military Impacts on Biodiversity
 - Emerging and Contemporary Technologies in Remote Sensing for Ecosystem Assessment and Change Detection on Military Installations
 - Diagnostic Tools and Reclamation Technologies for Mitigating Impacts of DoD/DOE Activities in Arid Areas



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LMS Field Application Site-MCAGCC

Products From LMS Application

- Development of computer based land management models and capabilities specific to arid and semiarid regions
- Improved LCTA protocols and ability to effectively use LCTA data in EDYS, carrying capacity simulation, and wind erosion models
- Improved GIS map dissemination capabilities



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LMS Field Application Site-MCAGCC

Products From LMS Application

- WEPS field data (24 consecutive months)
- Preliminary WEPS simulations for non-agricultural, military landscapes
- GIS map layers depicting chronological rare event wind and water erosion, aeolian erosion vulnerability, "potential erosion trigger sites" for future wind and water erosion events, and nutrient enrichment/depletion sites for land rehabilitation planning



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LMS Field Application Site-MCAGCC

Tri-Service/DoD Conservation User Requirements Addressed by Application at MCAGCC

- Land Capability and Characterization #3
 - Land based carrying capacity
 - Wind erosion modeling
 - GIS enabling technologies
- Land Rehabilitation #4
 - Catastrophic wind/water erosion
 - Nutrient dynamics



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LMS Field Application Site-MCAGCC

Collaborators

- Tierra Data Systems, Escondido, California
 - Liz Kellogg
- Sam Houston State University
 - Dr. Chris Baldwin
- Mojave Desert Ecosystem Project
 - Clarence Everly
- Oregon State University
 - Dr. Kate Lajtha
- SERDP
 - Dr. Robert Holst



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LMS Field Application Site-MCAGCC

Collaborators

- USDA, ARS, Wind Erosion Research Unit
 - Dr. Ed Skidmore
- Shepherd Miller
 - Dr. Terry McLendon
- Desert Research Institute
 - Dr. Dave Mouat
- University of Nevada-Reno
 - Dr. Paul Tueller



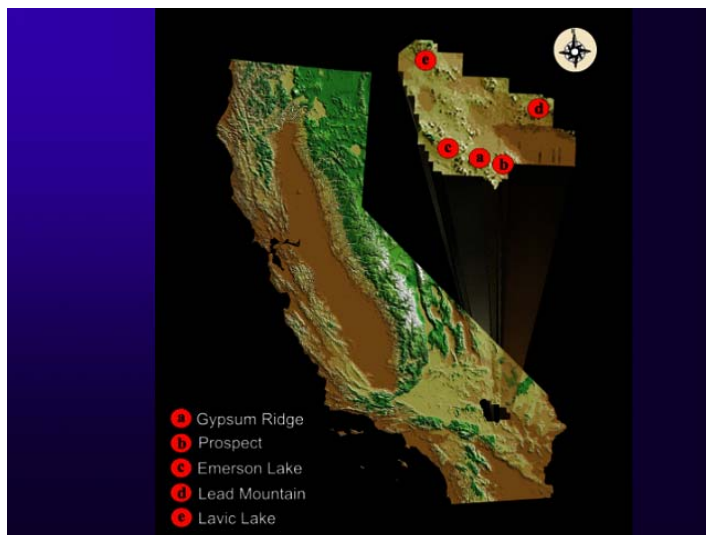
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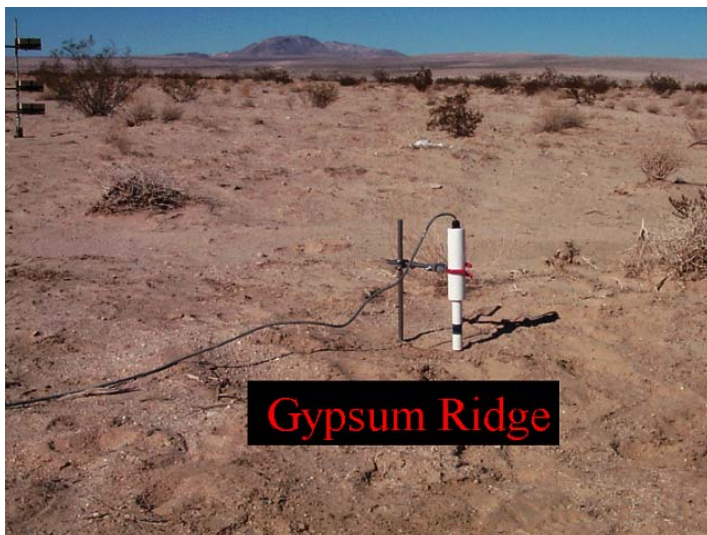
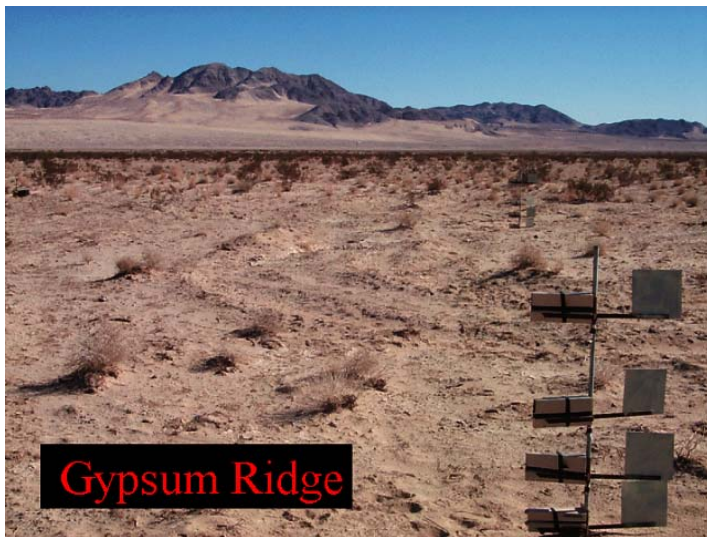
Engineer Research and Development Center

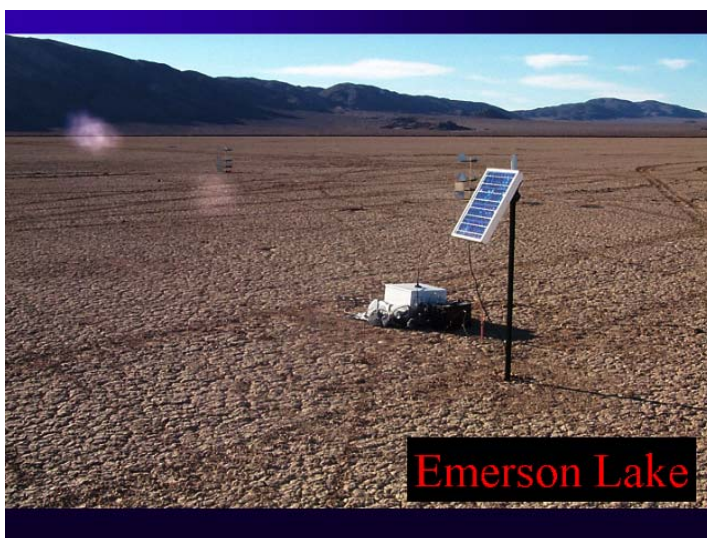
PRESENTATION: MCAGCC Wind Erosion.

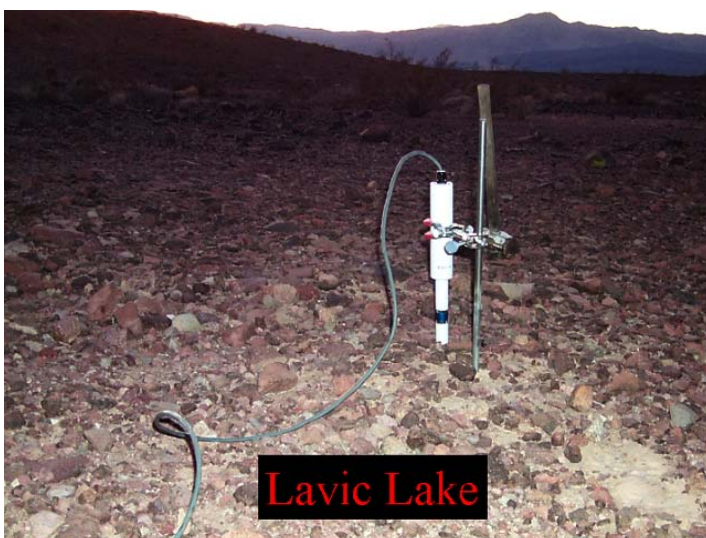
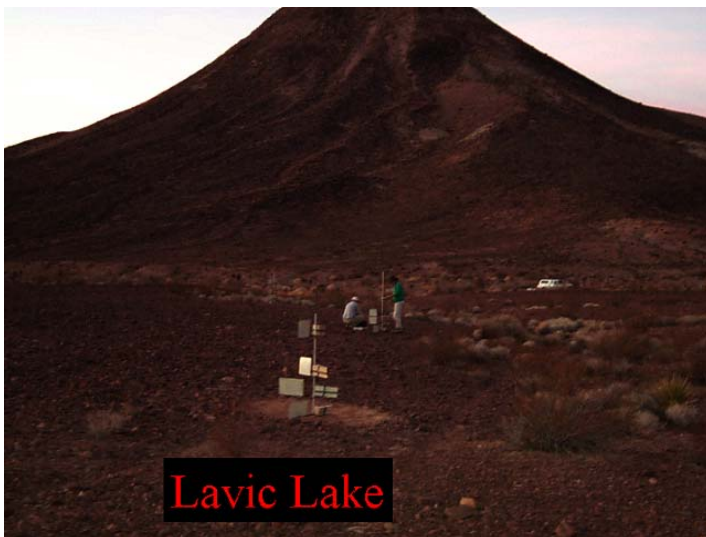
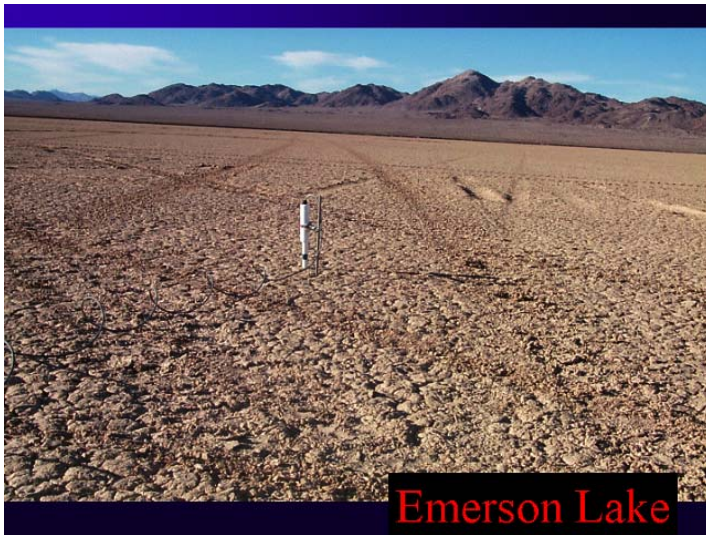
PRESENTER: Dr. Ed Skidmore.

WIND EROSION FROM MILITARY TRAINING LANDS

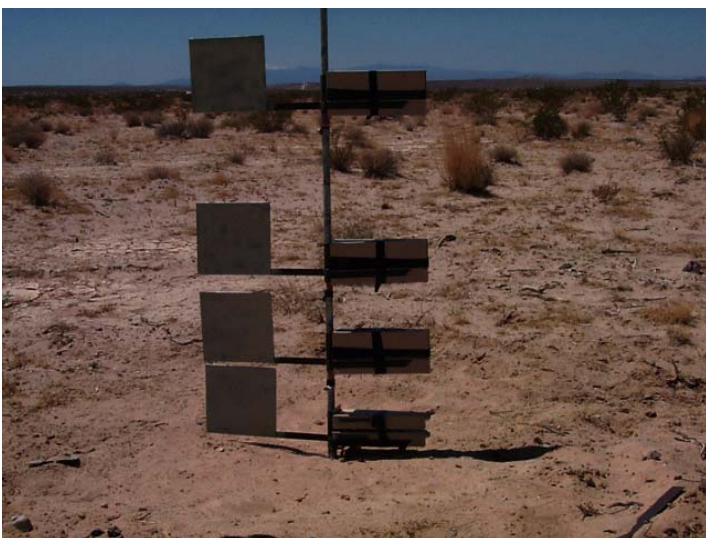


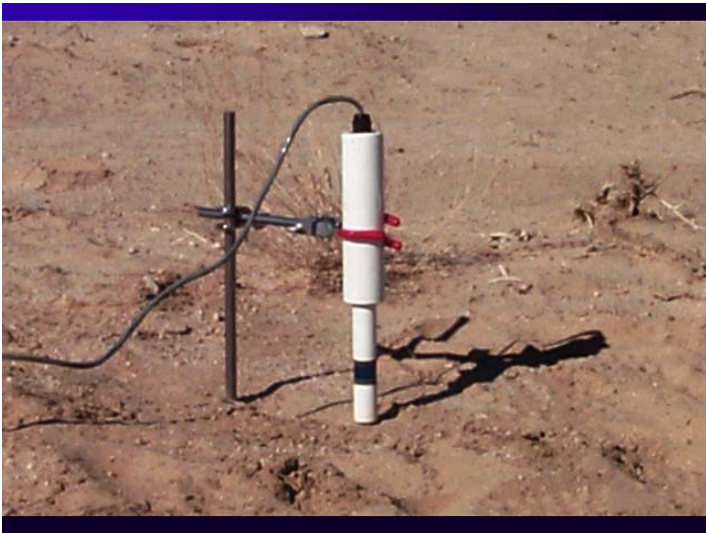


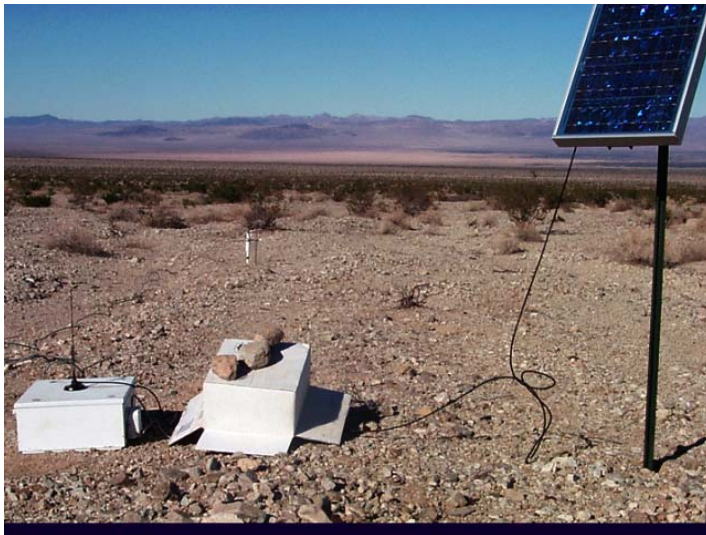












Wind data from
weather/PM10 stations
located near
BSNE/Sensit sites



Sampled top soil at each BSNE station
(5 at each site) in January 2001

- Texture
- Rock fraction
- Aggregate size distribution
- Aggregate stability

Field conditions

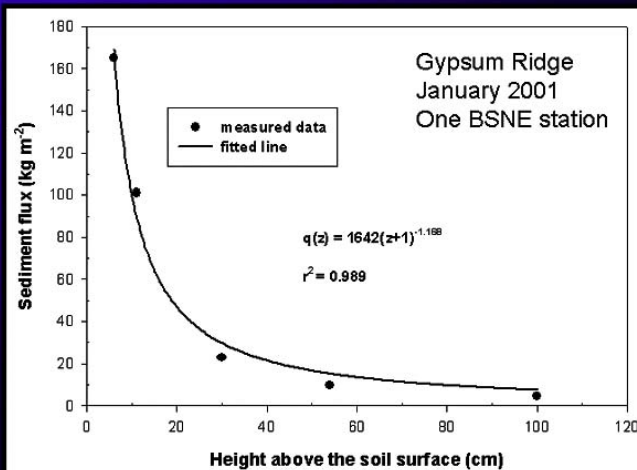
	Gypsum Ridge	Prospect	Emerson Lake	Lead Mountain	Lavic Lake
Sand (%)	91	90	23	82	56
Silt (%)	6	8	33	15	34
Clay (%)	3	2	44	3	10
USDA classific.	Sand	Sand	Clay	Loamy sand	Sandy loam

Field conditions, cont.

	Gypsum Ridge	Prospect	Emerson Lake	Lead Mountain	Lavic Lake
Rocks > 2 mm (%)	10	30	0	66	81
Aggregates < 0.84 mm (%)	79	60	17	27	17

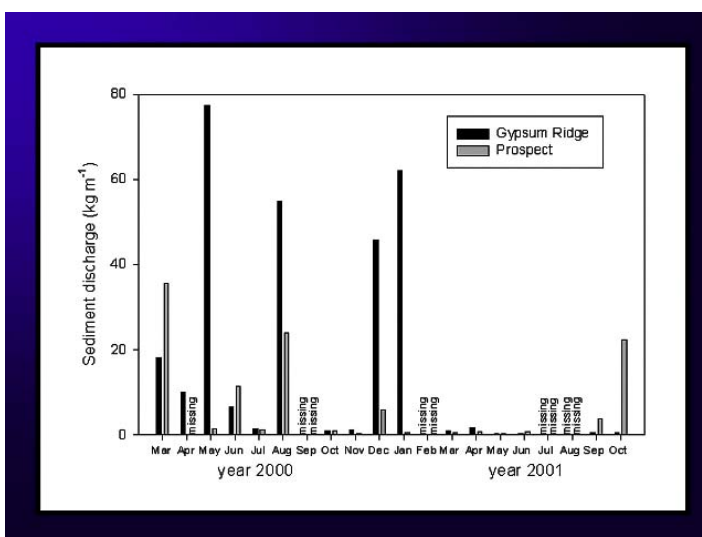
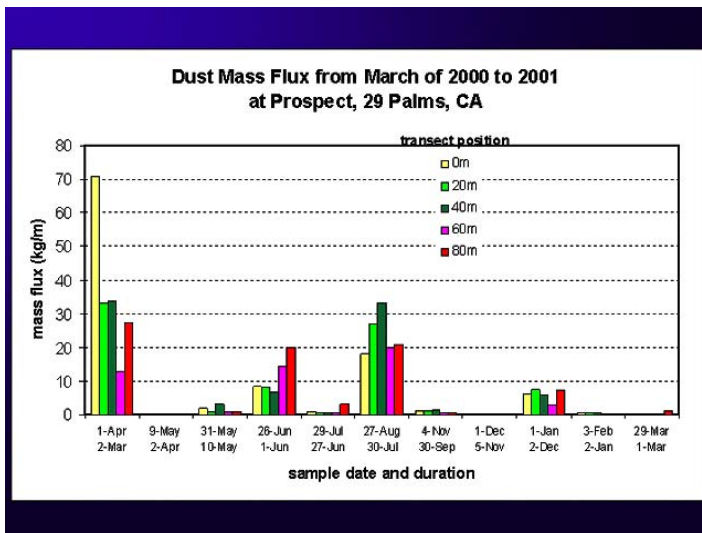
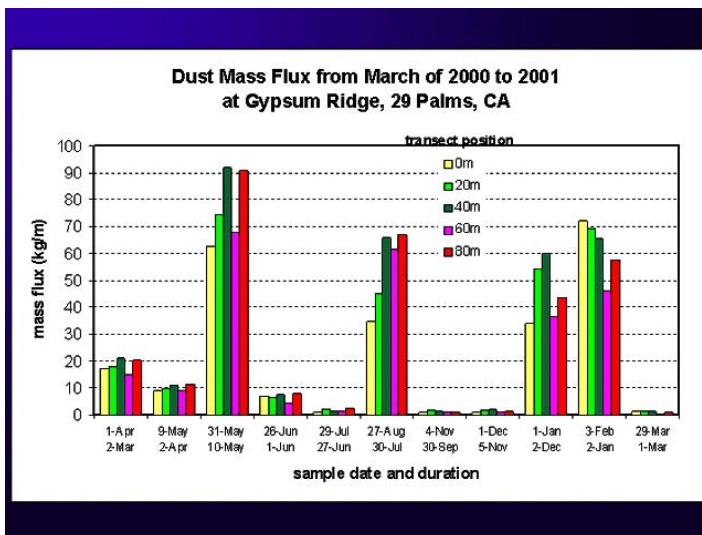
Field conditions, cont.

	Gypsum Ridge	Prospect	Emerson Lake	Lead Mountain	Lavic Lake
Dry agg. stab. (ln[J/kg])	-	-	2.61	-	-
Wet agg. stab. (%)	0	0	2.5	0	0



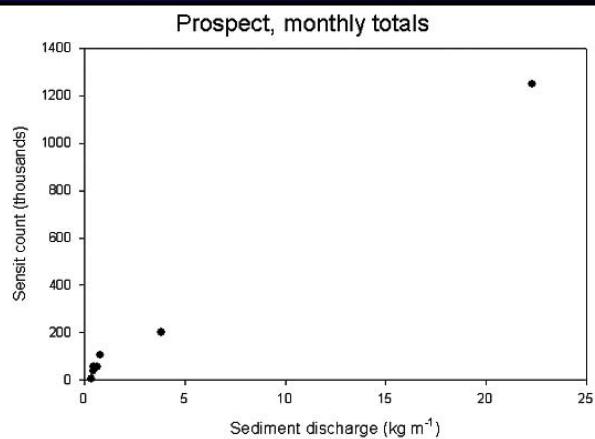
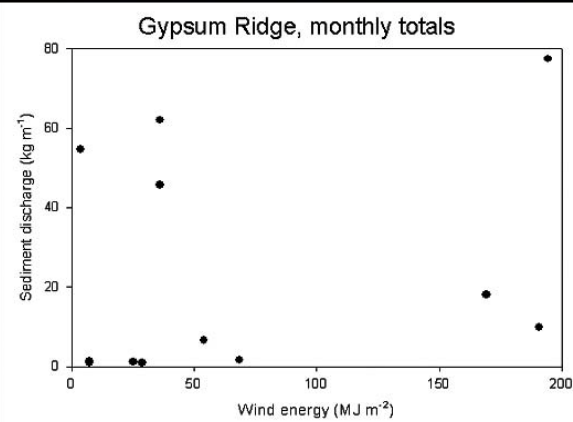
Sediment flux (kg/m²) for Gypsum Ridge, Jan. 2001

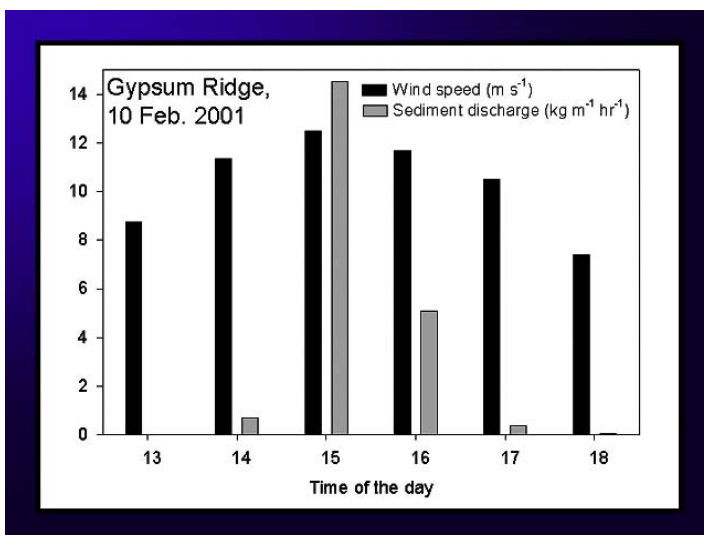
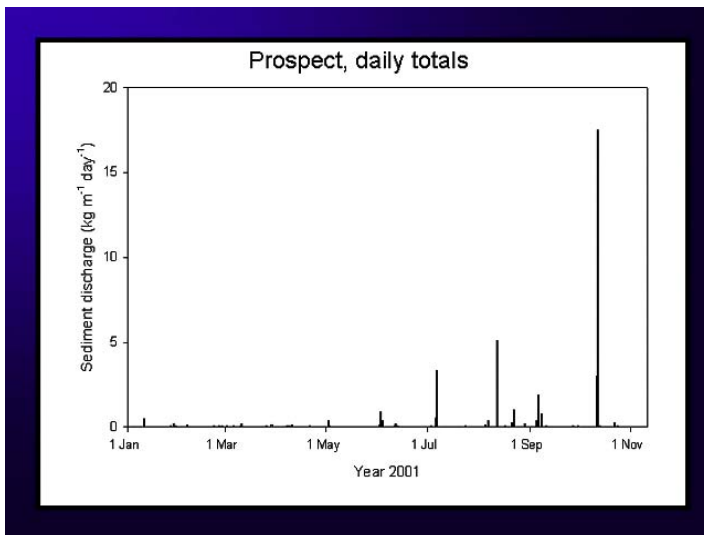
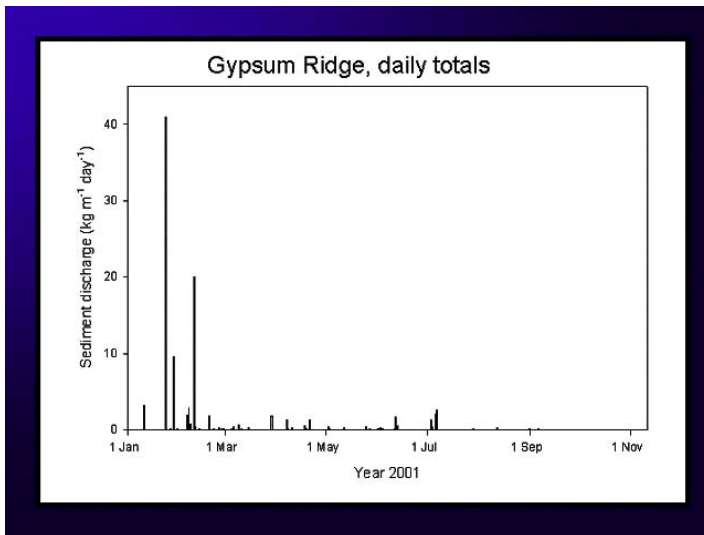
Height (cm)	0*	20*	40*	60*	80*
5	205	205	221	145	165
10	174	112	148	95	101
30	27	24	23	22	23
55	11	10	10	9	9
100	5	5	5	4	4
kg/m	71	69	65	45	57

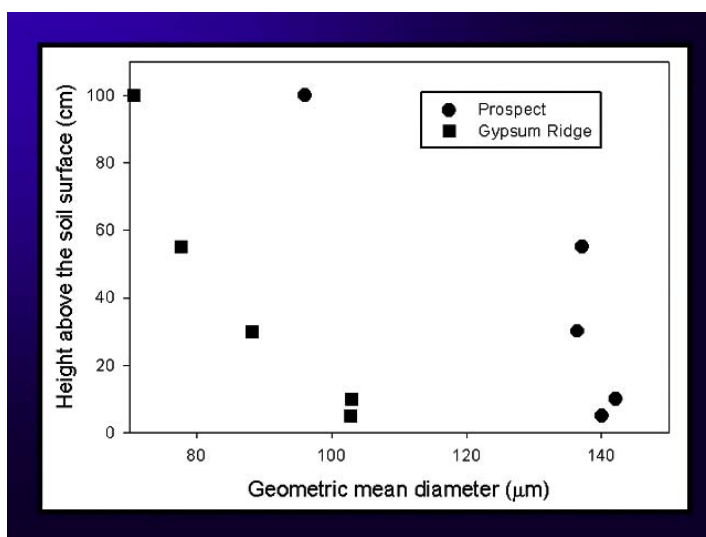
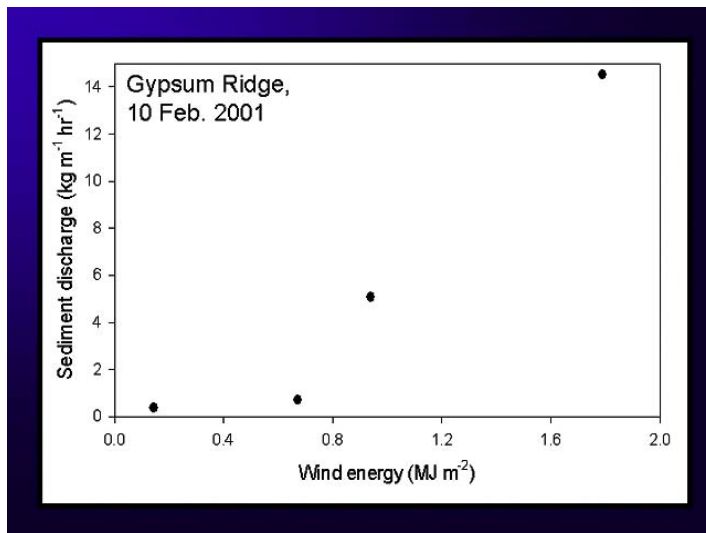
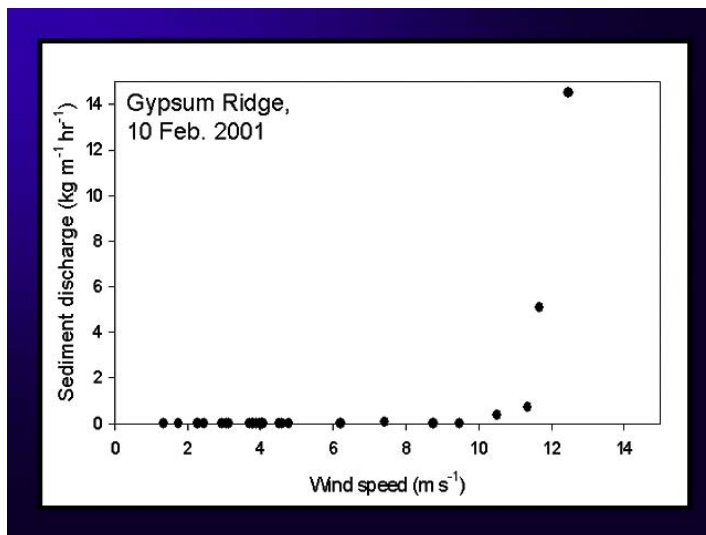


Total sediment transport for 17 months

Site	Sediment discharge (kg/m)
Gypsum Ridge	311
Prospect	110
Emerson Lake	5
Lead Mountain	7
Lavic Lake	7







Proposed work

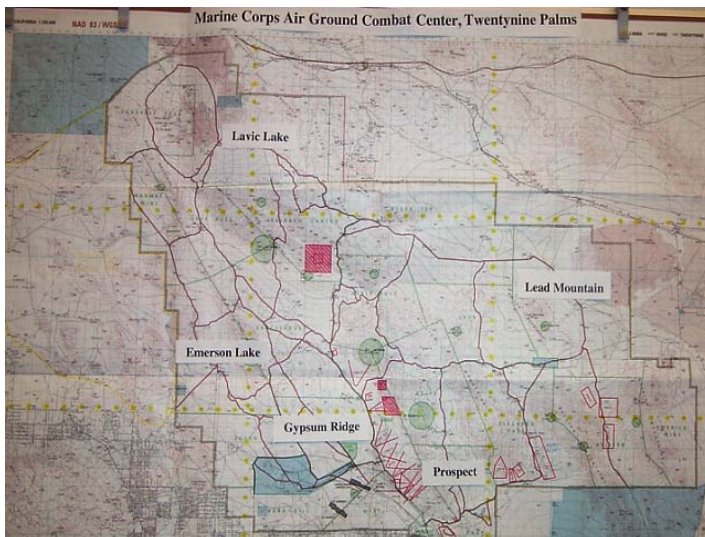


conclusions

- conclusion1
- conclusion2
- conclusion3
- conclusion4

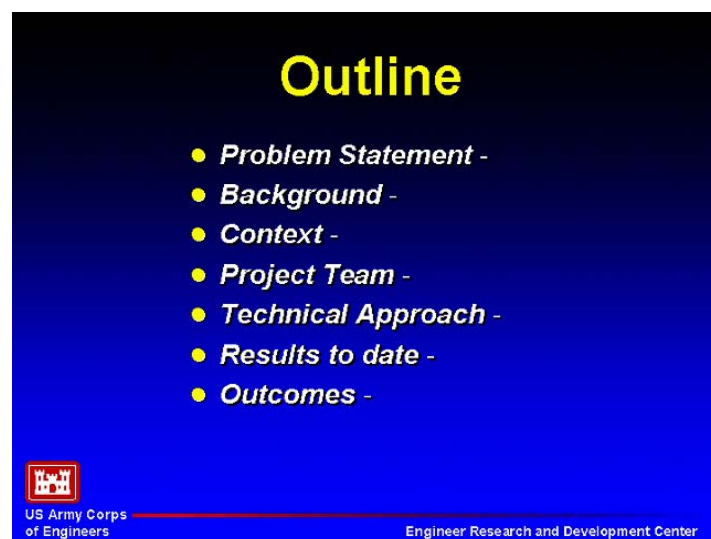
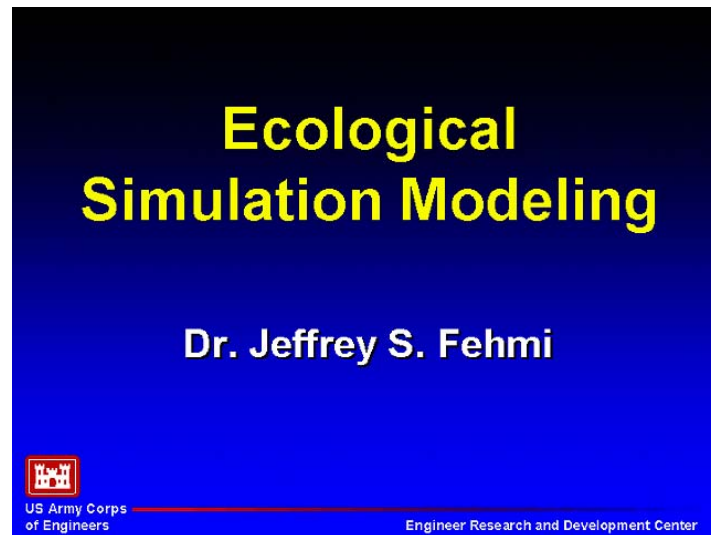
extra slides follow





PRESENTATION: Ecological Dynamics Modeling.

PRESENTER: Dr. Jeffrey Fehmi.



Outline



- **Problem Statement** - what is the driving concern for this work
- **Background** -
- **Context** -
- **Project Team** -
- **Technical Approach** -
- **Results to date** -
- **Outcomes** -



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Why we want computer models for land management



- Land management is complex and lacks well documented mechanistic cause-and-effect relationships.
- It is locally unique.
- It is dynamic – changing as conditions, force structure, and public concern change.



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Benefits of modeling



- Creates a structure to organize data and knowledge
- Reveals knowledge gaps
- Allows prioritizing of effects and interactions
- Shows research applicability
- Simplifies the system to allow easier access and creation of “what if” scenarios

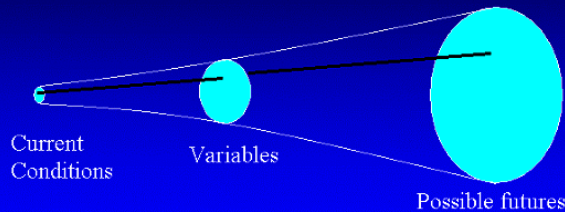


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Usual stated purpose of modeling

To predict future conditions using the best available science



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Outline

- **Problem Statement** –
- ➔ ● **Background** - what's the context for this work and what other previous work has been done that is being drawn upon
- **Context** -
- **Project Team** -
- **Technical Approach** -
- **Results to date** -
- **Outcomes** -



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Military training



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Military Training

- Military training is unique disturbance
- Training is different from other sorts of natural landscape disturbances such as grazing or fire.





Training occurs independently of the ability of the land to support it and frequency and intensity are often fixed by installation mission.

Training can occur in all weather conditions and across almost all soils, topographic aspects and vegetative types.



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Training is not selective, impacting all vegetation in some areas while others are untouched.

No nutrients are removed and manipulation of the vegetation is not the purpose.



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Military Land Management

- There are many complex variables including:
 - Weather
 - Season
 - Soil type
 - Training history
 - Vegetation
 - Intensity and unit type impacts vary



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Military Land Management

- Training is not linked to resource status
- Monitoring and analysis are constrained
- Scientific research generally does not effectively address management implications
- Knowledge not well captured in documentation



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Outline

- *Problem Statement* –
- *Background* -
- ➔ • *Context* - how does this specific project fit into the whole (is it a portion of another project)
- *Project Team* -
- *Technical Approach* –
- *Results to date* -
- *Outcomes* -



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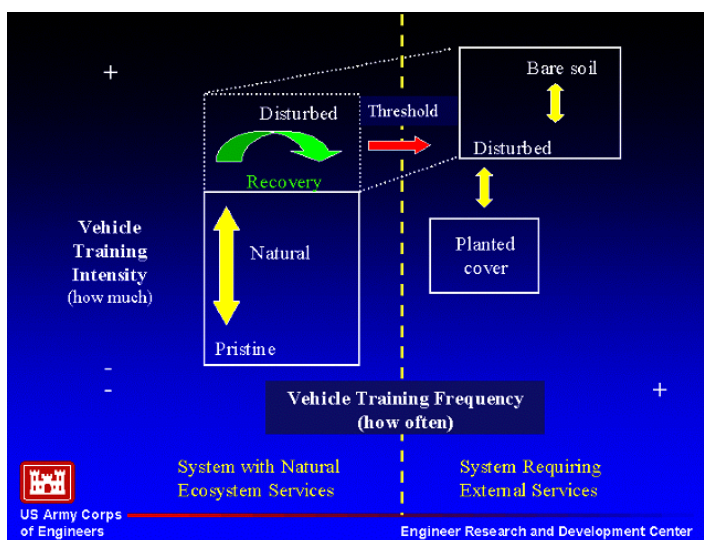
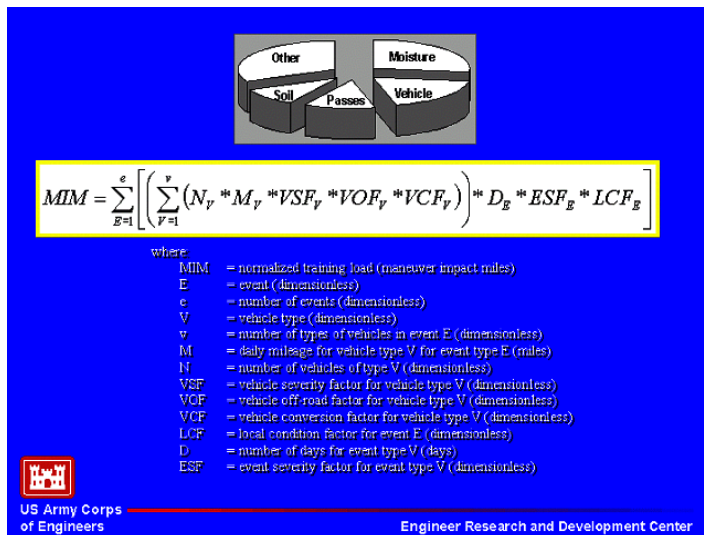
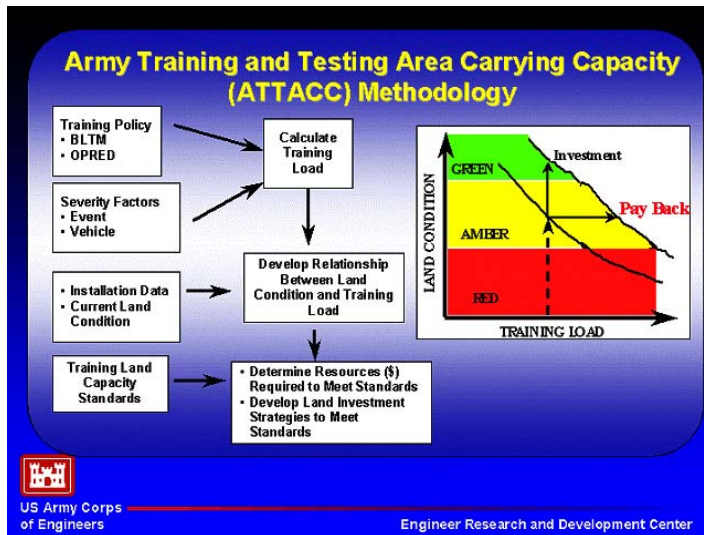
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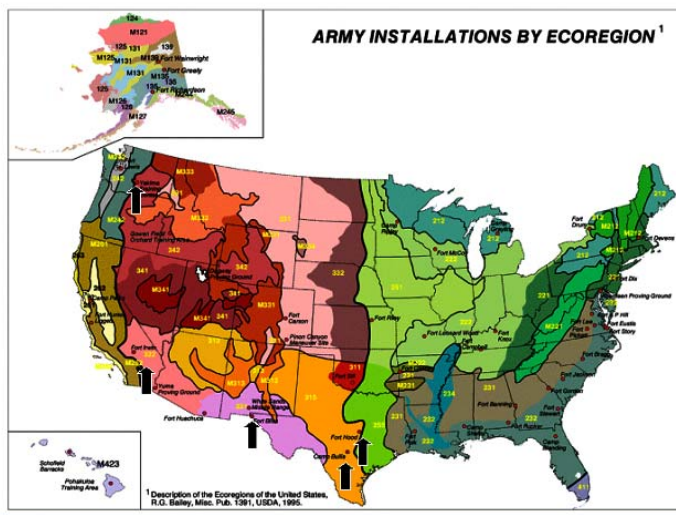
Context



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Outline

- *Problem Statement –*
- *Background -*
- *Context -*
- ➔ ● *Project Team -* who are the performers
- *Technical Approach –*
- *Results to date -*
- *Outcomes -*



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Project Team

- **ERDC -** David Price, Patrick Guertin, Dick Gebhart, Jeffrey Fehmi, William Severinghaus, William Goran
- **Contractor -** Terry McLendon, Michael Childress, Cade Coldren, Michael Meyer
- **MCAGCC -** Rhys Evans, Val Prehoda, Roy Madden, Kip Otis-Diehl, Chris White, Rob Palmer, Dawn Lawson



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Outline

- *Problem Statement* –
- *Background* -
- *Context* -
- *Project Team* -
- ➔ • *Technical Approach* - what is the technical approach
- *Results to date* -
- *Outcomes* -



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Technical Approach



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Putting a model together

- ♦ Identify plant and animal communities through analyzing monitoring data
- ♦ Get soil, climate, and elevation data
- ♦ Develop an exhaustive bibliography of everything published about the plants, animals, soils and climate
- ♦ Divide the landscape into smaller units and build list of characteristics for each unit
- ♦ Begin to put together model using best available data for knowledge gaps



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Resource Exchange



Target cell gains or loses resources based on characteristics and occupants of neighbors.

Empirical data should be used to establish the resource exchange between cells.



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Putting a model together

- Put caps on the amounts of biomass and nitrogen use
- Begin iteratively testing and adjusting parameters such as water use efficiency or carbon cycling until they are within a realistic range
- Test the model with known weather, plant and animal sequences
- Adjust as appropriate
- Release draft



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Outline

- *Problem Statement -*
- *Background -*
- *Context -*
- *Project Team -*
- *Technical Approach -*
- *Results to date -*
- *Outcomes -*

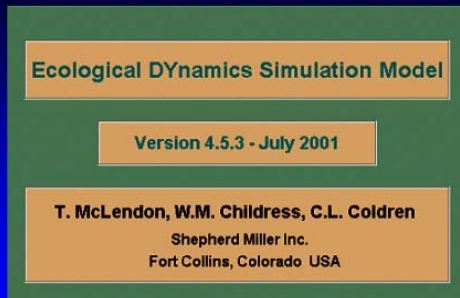


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Results to date -

- The development of the EDYS model.



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EDYS Developed for Texas

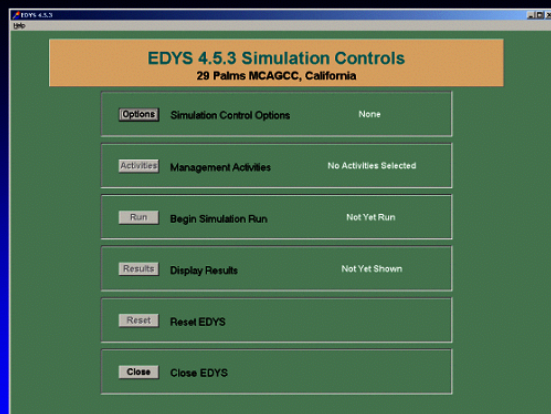
- Original model developed by Dr. Terry McLendon for the region around El Paso, Texas
- First military use was at Fort Hood, followed by Fort Bliss.
- Current CERL program has developed version for Fort Bliss, Fort Hood, Camp Bullis, Camp Stanley, Yakima Training Center, and Twentynine Palms.
- The model has seen other use across the southwestern US.



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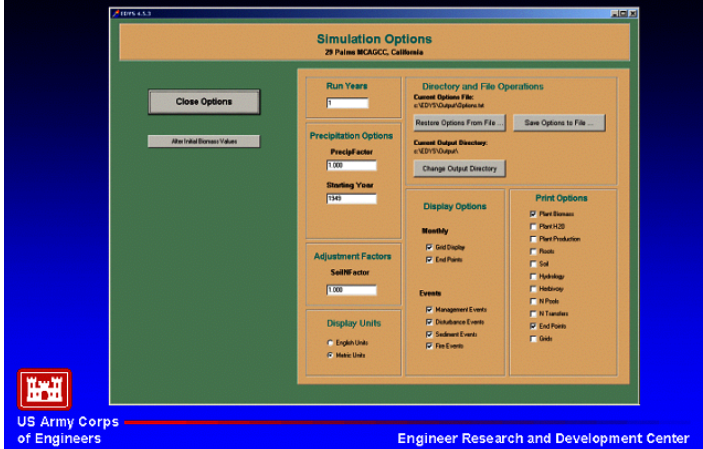
EDYS



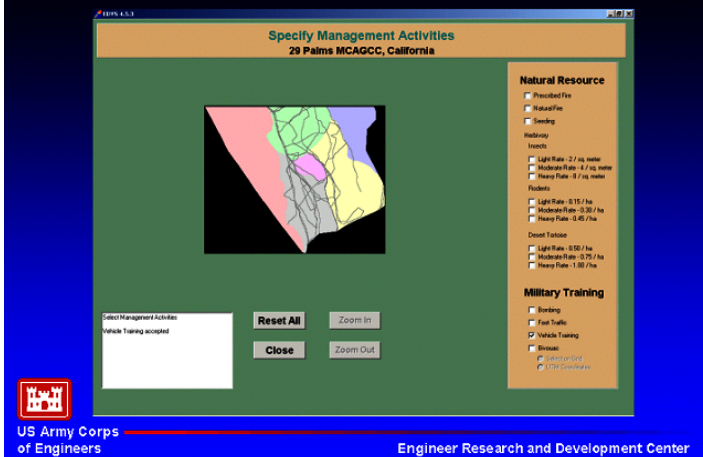
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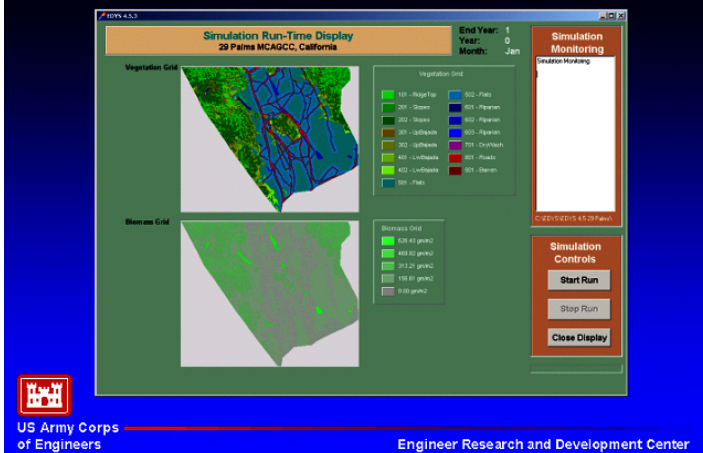
EDYS



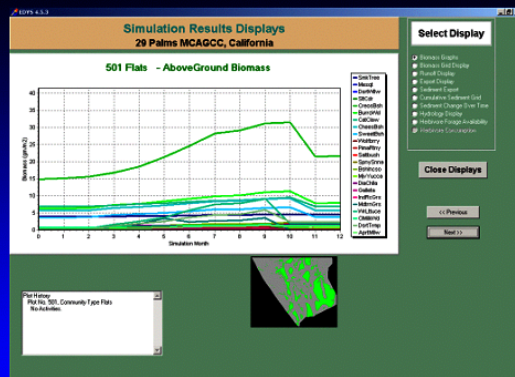
EDYS



EDYS



Management derived from EDYS



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What it does well

- Allows simulation of:
 - Biomass
 - Plant species
 - Fire
 - Military Disturbance
 - Bivouac
 - Several Vehicle Types



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What it does well

- Allows simulation of:
 - Herbivory
 - Erosion
 - Runoff
 - Rainfall Scenarios

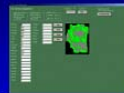


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What it does well

- Has point and click interface
- Outputs maps in a variety of formats
- Allows changes of initial vegetation types
- Requires little training to use
- Effective explanation/education tool



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What could be improved

- Model is Black Box to the user
 - No indication of how decisions are made (which research supports particular outcomes)
 - No indication of main assumptions



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What could be improved

- Program crashes
- Program runs slowly
- Validation results are inconclusive



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Outline

- *Problem Statement -*
- *Background -*
- *Context -*
- *Project Team -*
- *Technical Approach -*
- *Results to date -*
- *Outcomes -*



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Outcomes

- Analyzed LCTA data for changes and community types
- Analyzed improved methods for future monitoring
- Collated data together and provided database to installation



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Outcomes

- Provided management recommendations
- Released model for installation use – model will produce GIS layers of the simulations
- At least two technical reports and potentially one peer reviewed publication will come out of this work



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Benefits of modeling



- Creates a structure to organize data and knowledge
- Reveals knowledge gaps
- Allows prioritizing of effects and interactions
- Shows research applicability
- Simplifies the system to allow easier access and creation of “what if” scenarios



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Champaign, IL 61822
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Fax: 217-373-7266
jeffrey.s.fehmi@erdc.usace.army.mil

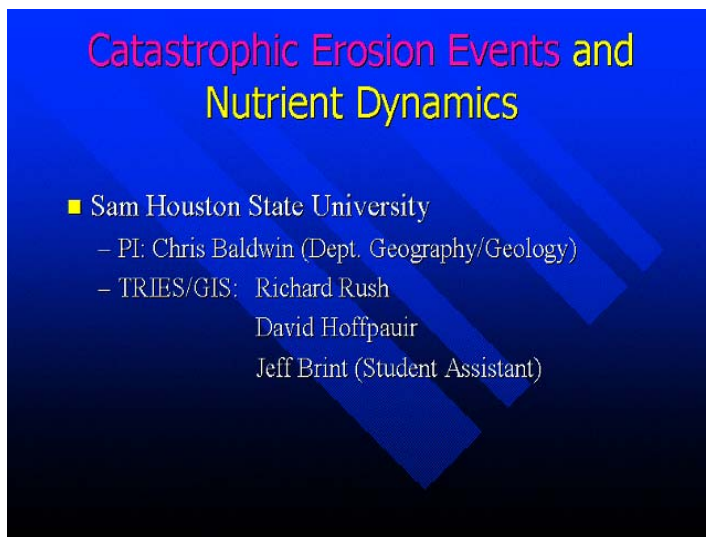
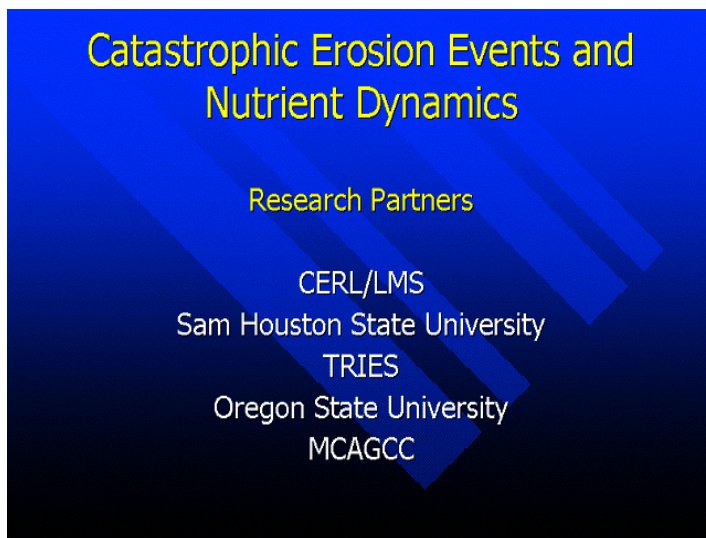


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PRESENTATION: Catastrophic Erosion Events and Nutrient Dynamics.

PRESENTER: Dr. Chris Baldwin.

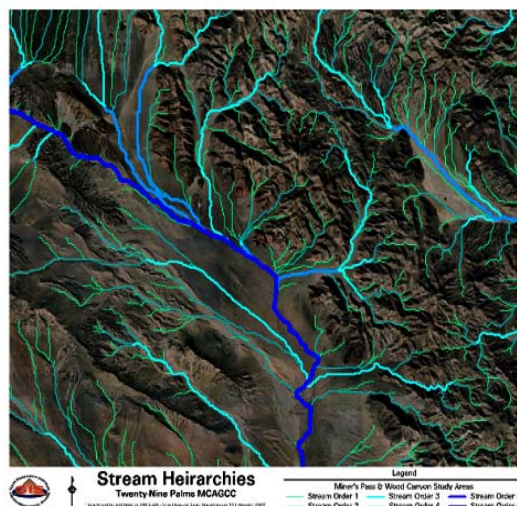
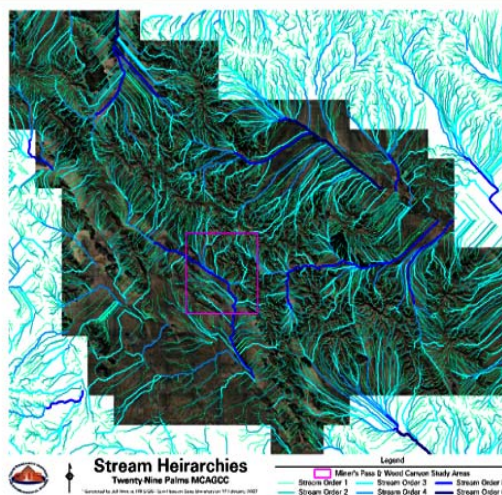


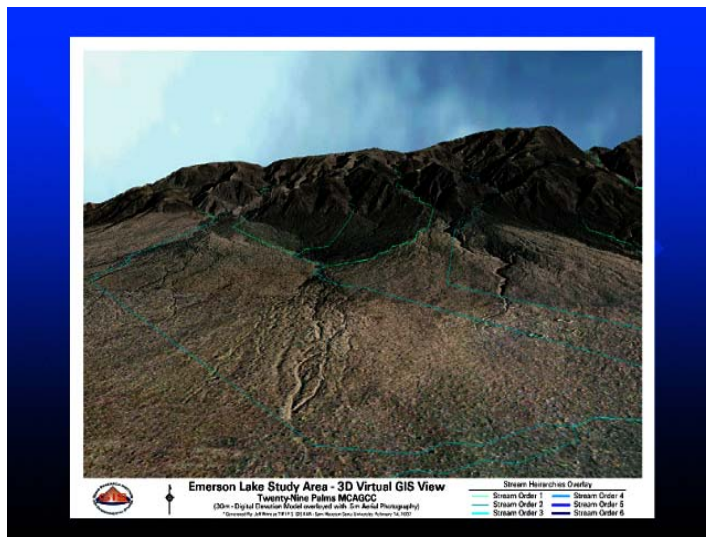
Catastrophic Erosion Events and Nutrient Dynamics

❖ Broad Tasks

1. Flash flood hazard mapping

- Stream hierarchies
- Slope characteristics
- Substrate characteristics
- Use characteristics





Catastrophic Erosion Events and Nutrient Dynamics

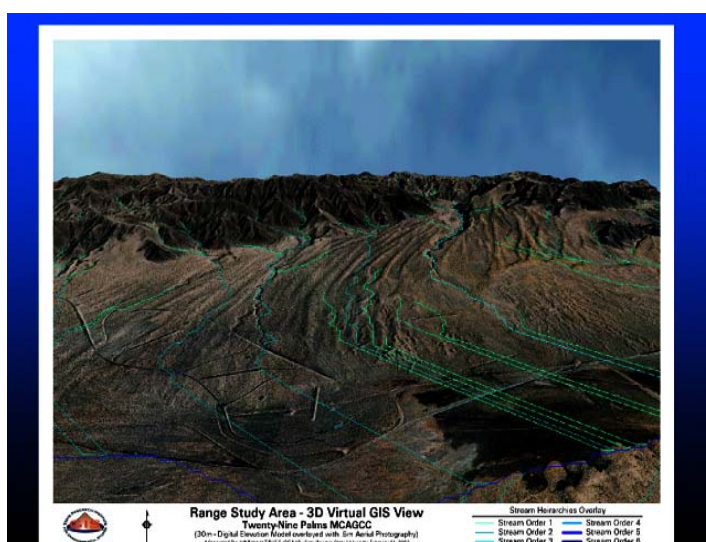
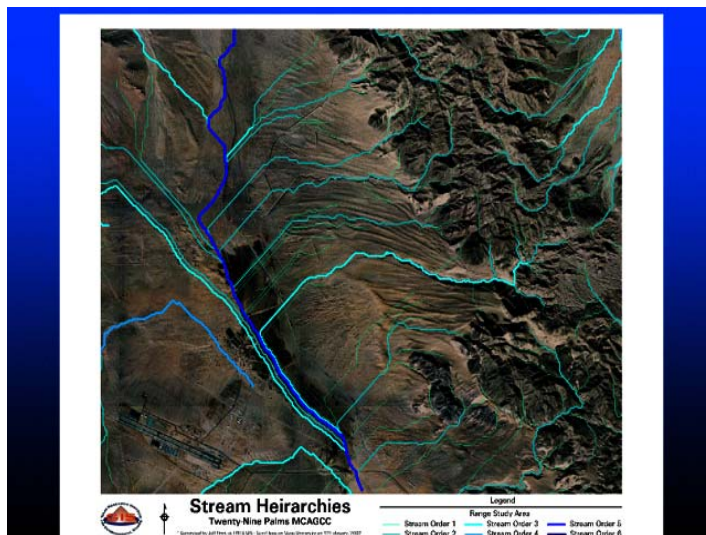
❖ Broad Tasks

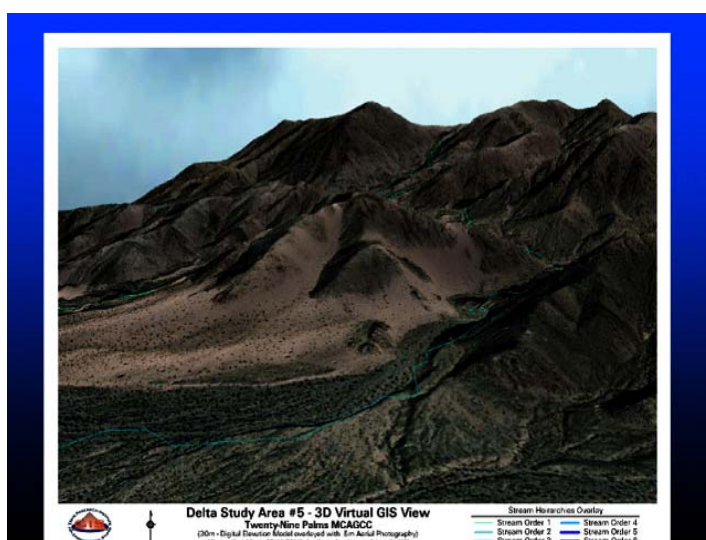
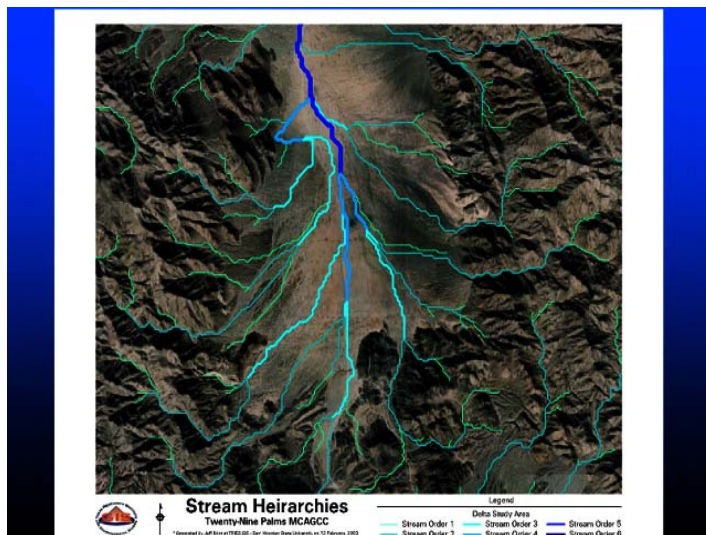
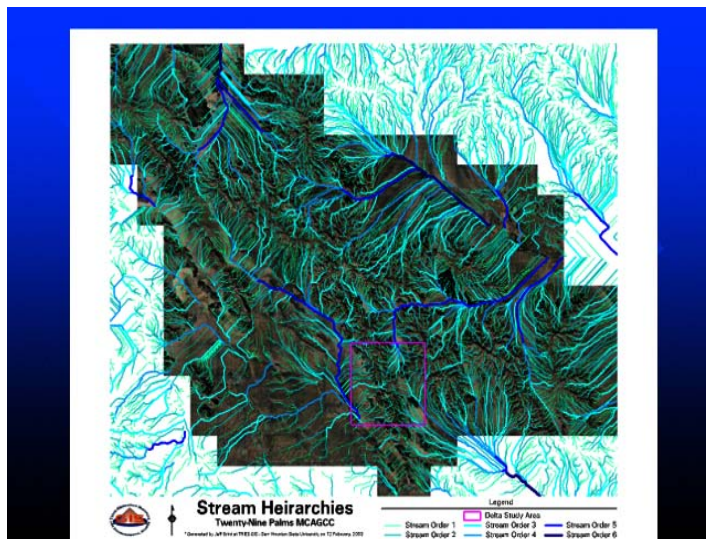
1. Flash Flood Hazard Mapping
2. Sediment Sources and Sinks
 - Ambient circulation
 - regional + playas
 - Base circulation
 - natural + anthropogenic
 - Closed loop fan circulation

Catastrophic Erosion Events and Nutrient Dynamics

❖ Broad Tasks

1. Flash Flood Hazard Mapping
2. Sediment Sources and Sinks
 - Bajada sand ramps
 - High elevation conduits and leakage
 - Secondary ramps
 - Changed fan drainage characteristic
 - Resources and Hazards





Catastrophic Erosion Events and Nutrient Dynamics

❖ Broad Tasks

1. Flash Flood Hazard Mapping
2. Sediment Sources and Sinks
3. MIS inputs to military use of desert systems
4. Nutrient Dynamics

Catastrophic Erosion Events and Nutrient Dynamics

Catastrophic Erosion Events and Nutrient Dynamics

■ Oregon State University

- Kate Lajtha (Dept. Forestry/Botany)
- Julie Spears (Graduate Assistant)

PRESENTATION: Change Detection / Remote Sensing at MCAGCC.

PRESENTER: Dr. Tom Frank & Mr. Scott Tweddale.

RSEA Remote Sensing for Ecosystem Assessment

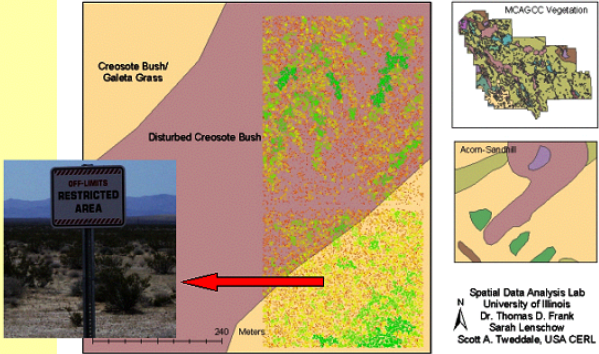
FY02 In-Progress Review (IPR) for Mojave Desert (Twentynine Palms) Land Management System (LMS) Military Field Application Site

Emerging and Contemporary Technologies in Remote Sensing for Ecosystem Assessment and Change Detection on Military Reservations



RSEA Remote Sensing for Ecosystem Assessment

Acorn-Sandhill Standing Woody Biomass



Now military land managers will have the tools to monitor secondary plant succession with emerging high spatial and spectral resolution imagery.

Spatial Data Analysis Lab
University of Illinois
Dr. Thomas D. Frank
Sarah Lenschow
Scott A. Tweddale, USA CERL

RSEA Remote Sensing for Ecosystem Assessment

Research Objectives

Image Cover Measurements to Field Transect Cover:

What spatial resolution agrees most closely with field observations?

Image Biophysical Variables to Field Transect Cover:

Is it possible to predict cover directly from image variables such as NDVI, albedo, and texture directly without performing image classification and recoding to cover?

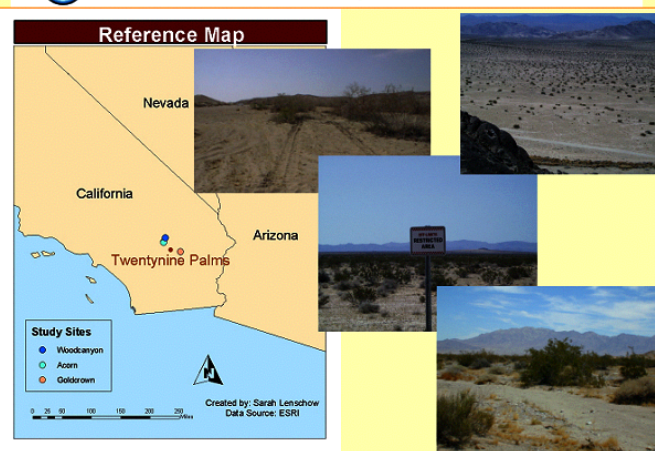
Scaling up cover from High Resolution to Landscape Scales:

How can detailed observations be sampled and then extrapolated over larger geographic extents (up-scaling)?

Extrapolating standing biomass estimates across the landscape:

What is the effect of using shrub area from multiple resolutions to predict standing woody biomass across the landscape. (Based on 2001 IPR discussion about wind erosion and successional modeling.)

RSEA Remote Sensing for Ecosystem Assessment



RSEA Remote Sensing for Ecosystem Assessment

Mapping Vegetation Cover

Step 1

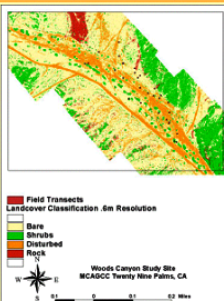
- Acquire nested spatial resolution imagery
- Georeference frames and mosaic imagery

- 0.2m Kodak
- 0.6m Camis
- 1.0m Camis
- 2.0 m Camis
- 1m IKONOS
- 4m IKONOS



Step 2

- Unsupervised training and maximum likelihood classification
- Recode classes to cover categories
- Compare image cover estimates to field cover



RSEA Remote Sensing for Ecosystem Assessment

Fixed radius plots, 2.5m radius, were selected as the means to measure total cover in the field.



- Random selection of sites within a study site
- Real-time differential correction of GPS point at center of study plot
- 10cm colored bands on a 2.5 meter scale rotated about center point
- size of each plant in the plot measured
- area of each plant calculated
- total cover of each plot measured as percent
- number of different plant species listed

For grass plots, 5 random azimuths centered on fixed radius plots were measured to acquire grass coverage

RSEA Remote Sensing for Ecosystem Assessment

Research Objectives

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What is the effect of using shrub area from multiple resolutions to predict standing woody biomass across the landscape. (Based on 2001 IPR discussion about wind erosion and successional modeling.)

RSEA Remote Sensing for Ecosystem Assessment

Cover estimates were derived from each of the nested spatial resolutions for each of the fixed radius transects

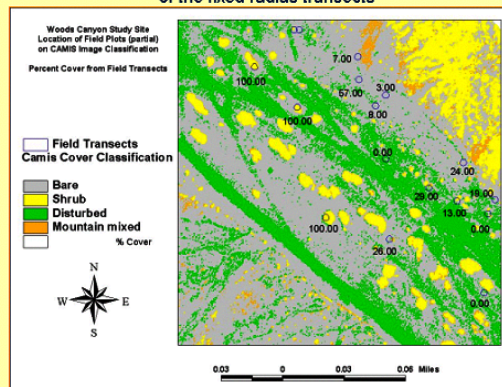
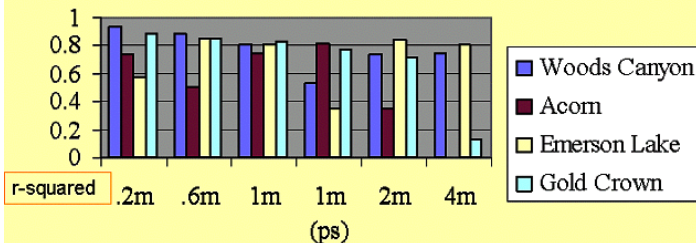




Image Cover Measurements Were Regressed Against Fixed Radius Transects to Determine Best Spatial Resolution to Map Arid Lands Vegetation Density



The correlation between image cover measurements and field cover measurements vary slightly from site to site along the environmental disturbance gradient, but overall, it appears that 1.0m spatial resolution provides most consistent relationship at all sites.

Testing of Significant Difference Between Area Measurements from Nested Spatial Resolutions

A multiple regression model was developed to determine if a significant difference existed between area measurements from the nested spatial resolutions.

where $Y_{i,j,k}$ is the response variable, ln cover;

Sp_i is the fixed effect of the i th Species;

$RSp_{i,j}$ is the interactive effect of i th Species and j th Resolution;

Si_k is the random effect of k th site, is normally distributed with 0 mean and σ_1^2 variance;

$SpSi_{i,k}$ is the random interaction of site and species, $\sim N(0, \sigma_2^2)$;

$I_{i,j,k}$ is random interaction of ID, Site and Species, $\sim N(0, \sigma_3^2)$;

$E_{i,j,k,l}$ is the random error, $\sim N(0, \sigma^2)$



Pair Wise Comparison of Resolutions for *Chilopsis linearis*

Spatial Resolution	Sensor	Spatial Resolution				
		.2m	.6m	1m	1mrg	2m
.2m	Kodak					
.6m	Camis	0.78				
1m	Camis	0.11	0.19			
1mpan	IKONOS	0.00	0.00	0.09		
2m	Camis	0.00	0.00	.0001	.0001	
4m	IKONOS	0.00	0.00	.0001	.0001	0.80

Significant when p-value < .05

Note: 1m is not statistically different from other resolutions until 2m and 4m, thus 1m is the best resolution to map vegetation cover in this arid environment.



Pair Wise Comparison of Resolutions for *Larrea tridentata*

Spatial Resolution	Sensor	.2m	.6m	1m	1mrg	2m
.2m	Kodak					
.6m	Camis	.0001				
1m	Camis	.0001	.73			
1mpan	IKONOS	.0001	.37	.61		
2m	Camis	.0001	.0001	.00	.00	
4m	IKONOS	.0001	.0001	.0001	.0001	0.01

Significant when p-value < .05.



Pair Wise Comparison of Resolutions for *Psoralea arguta*

Spatial Resolution	Sensor	.2m	.6m	1m	1mrg	2m
.2m	Kodak					
.6m	Camis	.0001				
1m	Camis	.00	.22			
1mpan	IKONOS	.00	.15	.84		
2m	Camis	.0001	.90	.24	.17	
4m	IKONOS	.0001	.00	.00	.0001	0.01

Significant when p-value < .05.



Research Objectives

Image Cover Measurements to Field Transect Cover:

What spatial resolution agrees most closely with field observations?

Image Biophysical Variables to Field Transect Cover:

Is it possible to predict cover directly from image variables such as NDVI, albedo, and texture directly without performing image classification and recoding to cover?

Scaling up cover from High Resolution to Landscape Scales:

How can detailed observations be sampled and then extrapolated over larger geographic extents (up-scaling)?

Extrapolating standing biomass estimates across the landscape:

What is the effect of using shrub area from multiple resolutions to predict standing woody biomass across the landscape. (Based on 2001 IPR discussion about wind erosion and successional modeling.)

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Study Site	Resolution	r^2	a_0	a_1	a_2
Wood Canyon	Kodak 0.2m	.91	- 24.40	-0.004	2.79
	CAMIS 0.6m	.94	191.00	-1.020	1.66
	CAMIS 1.0m	.92	192.00	-1.050	2.13
	CAMIS 2.0m	.79	112.00	-0.640	4.10
	IKONOS 1.0m	.85	220.00	-0.640	0.93
Sandhill	Kodak 0.2m	.78	134.00	-0.390	-0.19
	CAMIS 0.6m	.49	183.00	-0.910	-0.72
	CAMIS 1.0m	.69	215.00	-1.100	-0.21
	CAMIS 2.0m	NA	NA	NA	NA
	IKONOS 1.0m	.29	222.00	-0.260	-0.78
Gold Crown	Kodak 0.2m	.72	- 69.60	0.300	1.58
	CAMIS 0.6m	.91	222.00	-1.140	0.45
	CAMIS 1.0m	.74	279.00	-1.440	0.80
	CAMIS 2.0m	.70	453.00	-2.530	-1.34
	IKONOS 1.0m	.80	332.00	-0.540	0.24

Correlation between biophysical variables (albedo and texture) and fixed radius transects indicate that an accurate predicted cover map can be made from these regression equations.

RSEA Remote Sensing for Ecosystem Assessment

Research Objectives

Image Cover Measurements to Field Transect Cover:

What spatial resolution agrees most closely with field observations?

Image Biophysical Variables to Field Transect Cover:

Is it possible to predict cover directly from image variables such as NDVI, albedo, and texture directly without performing image classification and recoding to cover?

Scaling up cover from High Resolution to Landscape Scales:

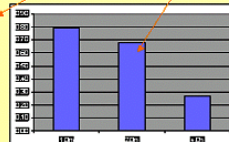
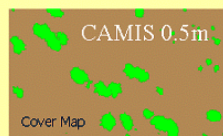
How can detailed observations be sampled and then extrapolated over larger geographic extents (up-scaling)?

Extrapolating standing biomass estimates across the landscape:

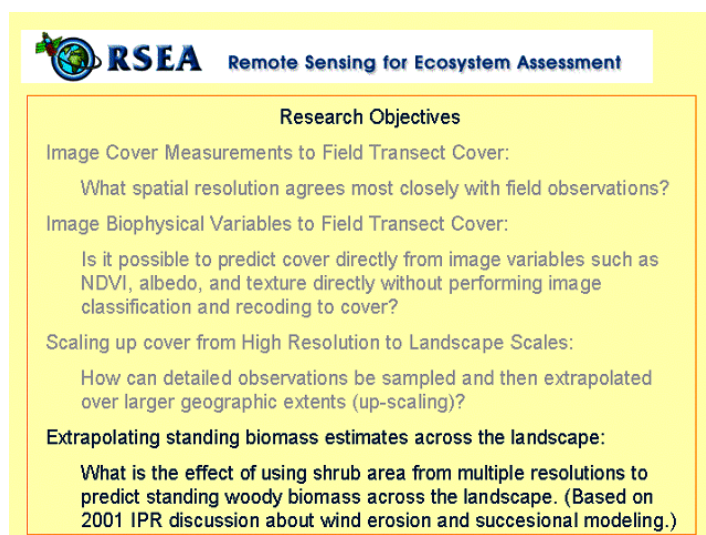
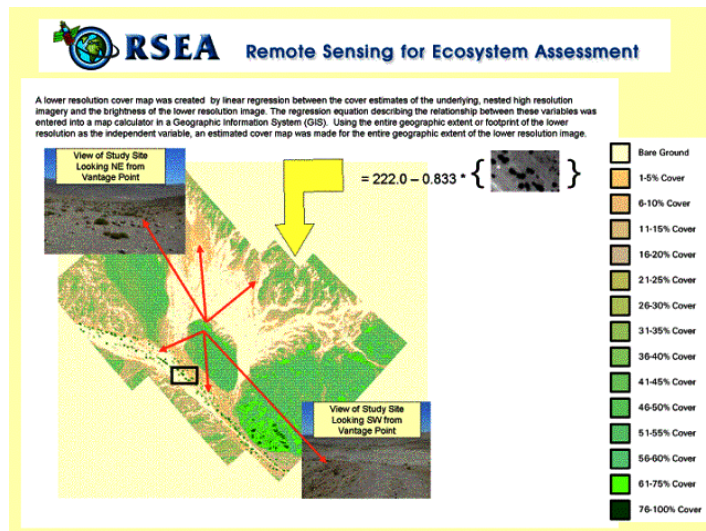
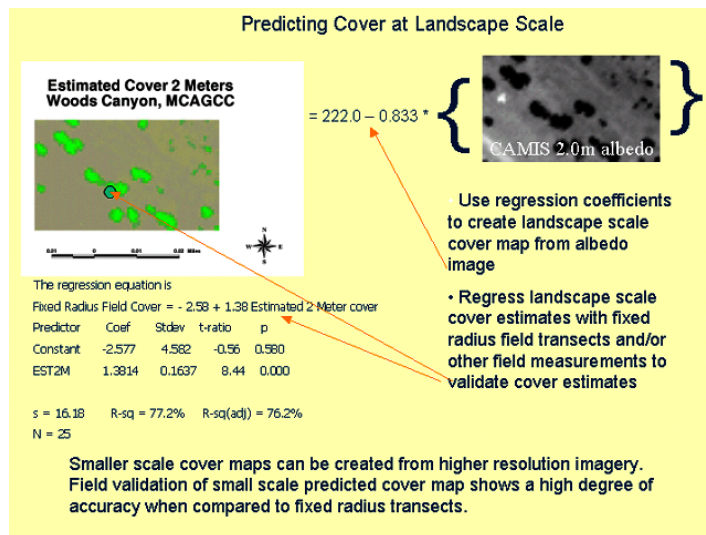
What is the effect of using shrub area from multiple resolutions to predict standing woody biomass across the landscape. (Based on 2001 IPR discussion about wind erosion and successional modeling.)

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Scaling Up from High Resolution Cover Samples to Landscape Scale Mapping Units



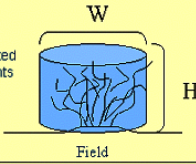

- Cover maps created
- Drop grid of landscape scale resolution on higher resolution cover image to measure cover for a larger pixel size
- Regress this larger pixel size cover to same landscape scale image albedo
- Use regression coefficients to create landscape scale cover map from albedo values
- Validate landscape scale cover estimates with field procedure



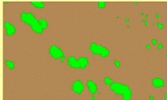
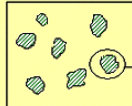

RSEA Remote Sensing for Ecosystem Assessment

Estimation of Standing Biomass $SWB = Cv * Area_c * GF * WF * Density$

Cylindrical volume of shrub computed from height and width measurements in field

$$Cv = \pi * (\frac{1}{2}W)^2(H)$$



Field








- Obtain area of 2-dimensional shrub from image
- Find greatest width (W) in image
- Calculate area top of cylinder (circle) $(\pi(\frac{1}{2}W)^2)$ tangent to perimeter of shrub on image

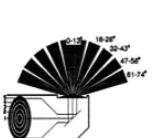
$Area_c$ = Area of 2-dimensional shrub from image
Area of circle tangent to perimeter of shrub on image

RSEA Remote Sensing for Ecosystem Assessment

$SWB = Cv * Area_c * GF * WF * Density$

The Li-Cor Plant Canopy Analyzer was used to acquire gap fraction measurements of desert shrub species.




Gap fraction measurements were made with Li-Cor Plant Canopy Analyzer, taking 1 above and 3 below canopy readings

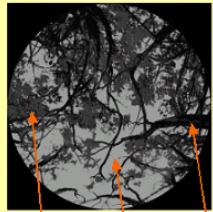
RSEA Remote Sensing for Ecosystem Assessment

$SWB = Cv * Area_c * GF * WF * Density$

Hemispheric Photograph



Classification



Foliage Sky Wood

Wood fraction measurements were derived from the classification of digital hemispheric images, separating canopy into foliage, sky and wood fractions.



$$SWB = Cv * Area_c * GF * WF * Density$$

Plant densities were derived using specific gravity (g/cm^3) of shrub species, which were then converted to density in kg/m^3

Species	Specific Gravity
Chilopsis linearis	0.59 g/cm^3
Larrea tridentata	1.10 g/cm^3
Psoralea arguta	0.55 g/cm^3



Regression Equations and Coefficients for Standing Woody Biomass vs. Imagery Area

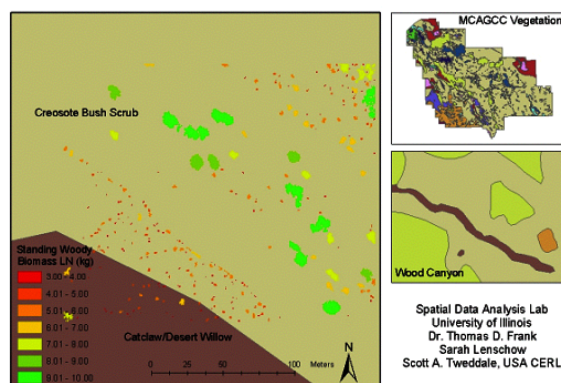
Spatial Resolution	Acom		Gold Crown		Wood Canyon	
	Equation	R ²	Equation	R ²	Equation	R ²
.2m	SWB = 4.40Cov ^{0.61}	.54*	SWB = 4.05Cov ^{1.50}	.88*	SWB = 4.87Cov ^{0.67}	.62*
.6m	SWB = 3.65Cov ^{1.24}	.77*	SWB = 2.06Cov ^{1.88}	.68*	SWB = 4.91Cov ^{1.08}	.72*
1m	SWB = 3.13Cov ^{1.33}	0.28	SWB = 2.99Cov ^{1.44}	.73*	SWB = 4.05Cov ^{1.28}	.89*
1mpan	SWB = 1.26Cov ^{1.88}	.56*	SWB = 3.83Cov ^{1.20}	.85*	SWB = 5.38Cov ^{0.89}	.71*
2m	SWB = .204Cov ^{2.80}	.90*	SWB = 3.67Cov ^{1.88}	.38*	SWB = 5.08Cov ^{0.48}	.36*
4m			SWB = 3.73Cov ^{0.64}	.51*	SWB = 7.86Cov ^{0.18}	0

(SWB) represents standing woody biomass. (Cov) represents imagery cover estimates.

* significant correlation ($P < .05$).



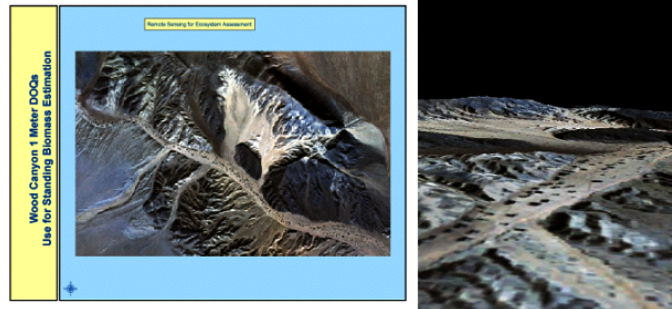
Wood Canyon Standing Woody Biomass



RSEA Remote Sensing for Ecosystem Assessment

Future effort:

- Apply regression equations to 1 meter DOQ albedo to estimate vegetation cover over larger regions.
- Develop field sampling strategy to validate estimates.



RSEA Remote Sensing for Ecosystem Assessment

Future effort:

- Use Regression Equations and Coefficients for Standing Woody Biomass vs. Shrub Area to Estimate Standing Woody Biomass Using 1m DOQ
- Develop field sampling strategy to validate biomass estimates

Spatial Resolution	Acom		Gold Crown		Wood Canyon	
	Equation	R ²	Equation	R ²	Equation	R ²
.2m	SWB = 4.40Cov ^{1.951}	.54*	SWB = 4.05Cov ^{1.50}	.88*	SWB = 4.87Cov ^{1.957}	.62*
.6m	SWB = 3.65Cov ^{1.24}	.77*	SWB = 2.06Cov ^{1.88}	.68*	SWB = 4.91Cov ^{1.08}	.72*
1m	SWB = 3.13Cov ^{1.23}	0.28	SWB = 2.99Cov ^{1.44}	.73*	SWB = 4.05Cov ^{1.28}	.89*
1mpan	SWB = 1.26Cov ^{1.86}	.56*	SWB = 3.83Cov ^{1.20}	.85*	SWB = 5.38Cov ^{1.88}	.71*
2m	SWB = .204Cov ^{2.80}	.90*	SWB = 3.67Cov ^{1.08}	.38*	SWB = 5.08Cov ^{1.948}	.36*
4m			SWB = 3.73Cov ^{1.964}	.51*	SWB = 7.86Cov ^{1.018}	0

RSEA Remote Sensing for Ecosystem Assessment



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Remote sensing based protocols and tools have been developed to assess and monitor the status and trends of military landscapes in arid and semi-arid environments.

This research has evaluated high spatial and spectral resolution sensors to map species composition, cover, and standing biomass along environmental, disturbance and successional gradients.

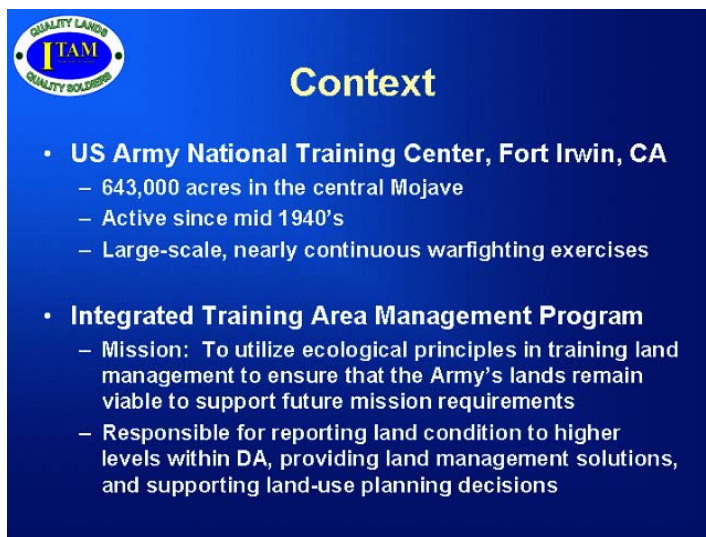
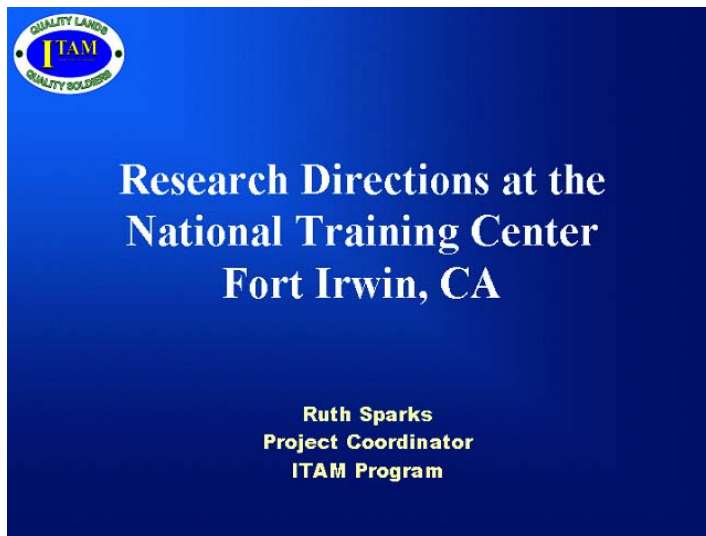
Plant species that are often associated with land degradation have been identified, and procedures for determining changes in plant species and plant communities related to degradation have been developed.

Ecotone boundaries have been examined to test the ability of various scales of imagery to define them in terms of both floristics, total vegetation cover, and soil surface differences.

A method to scale up vegetation cover estimates to larger geographic extents has been developed and tested for accuracy.

PRESENTATION: Research Directions at the National Training Center Fort Irwin, CA.

PRESENTER: Ms. Ruth Sparks.





Background

- Need to integrate monitoring and rehabilitation components
- Need to better understand plant-soil-water relationships
- Need to understand how vulnerability and recoverability vary across the landscape



Problem Statement



Impacts: How do different soils and landforms respond to different levels and types of disturbances?



Thresholds: How do we determine when and where to take management action?



Remedies: What rehabilitation practices are appropriate for given sites and conditions?



Current Research (1)

- CHARACTERIZATION OF SOIL DISTURBANCE
- Desert Research Institute (Dr. Eric MacDonald)
- Objectives
 - Identify key soil properties for quantifying disturbance
 - Quantify the relationship between degree of disturbance and surface age, soil development, and hydrologic processes





Soil Characterization Approach

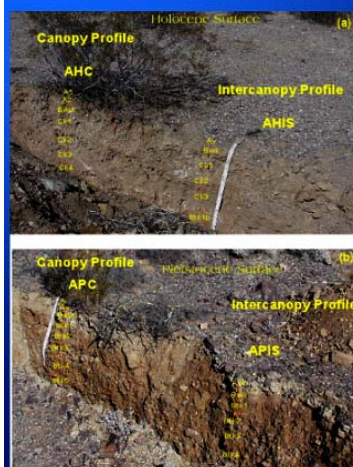
- Sampling locations
 - Three soil map units (different lithology)
 - Two surface ages (Pleistocene, Holocene)
 - Three disturbance levels
 - Shrub and inter-shrub space
- Sampling protocol
 - Full profile description for undisturbed site
 - Description of top 30-45 cm for disturbed sites
 - Texture, structure, roots, pores, cutans
- Parameters measured
 - Compaction (bulk density and penetrometer)
 - Infiltration (disc permeability)
 - Nutrients and chemistry (C, H, N, OM, CaCO₃, EC)



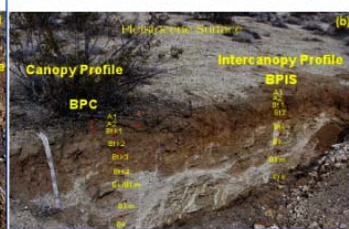
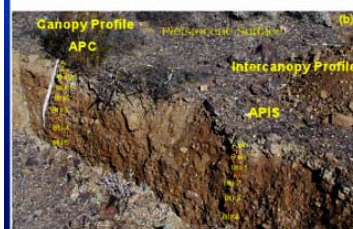
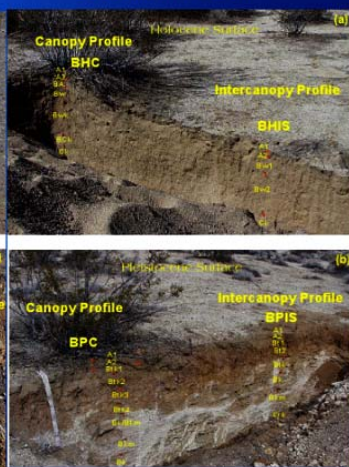
Soil Characterization Progress to date

- Profile descriptions of undisturbed sites for old and young surfaces within two map units are complete
- Description of disturbed locations and third soil map unit is in process
- Measurement of hydrologic and disturbance-related parameters scheduled for Spring FY02

Arizo/Twohitter



Cajon/Ambrosia





Soil Characterization Outcomes

- **Products**
 - Identification of key soil parameters for quantifying disturbance
 - Disturbance gradient for several soil types and surface ages
- **Applications**
 - Interpretation of soil measurements from long-term monitoring plots
 - Determining site preparation techniques appropriate to different levels of disturbance on different soils



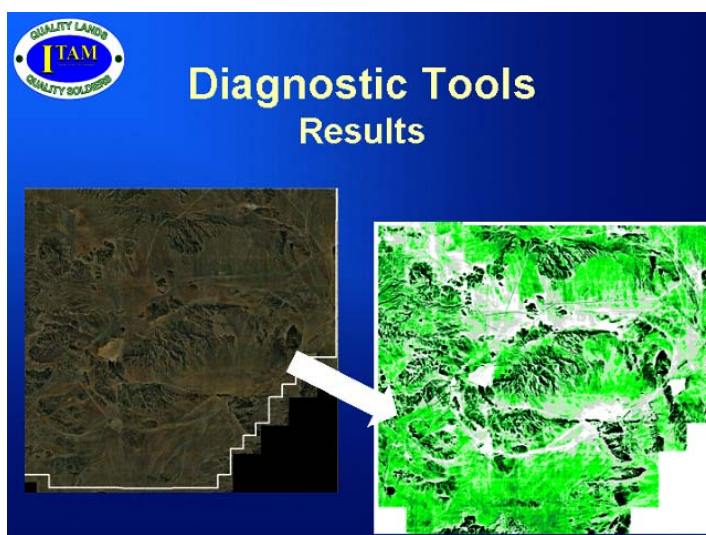
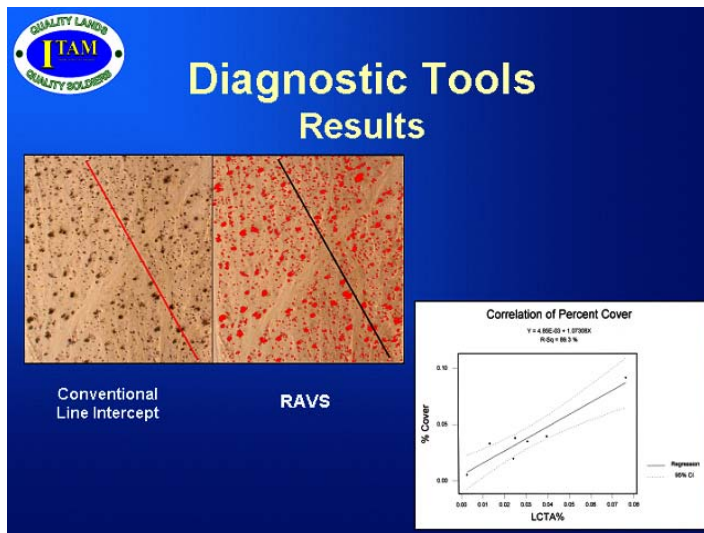
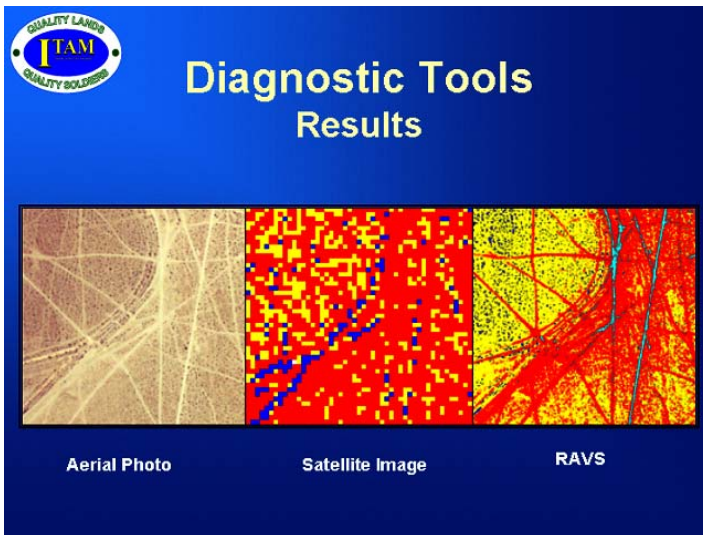
Current Research (2)

- DEVELOPMENT OF DIAGNOSTIC TOOLS
- SERDP - Bechtel-Nevada (Dr. Dennis Hansen)
- Objectives:
 - Bridge the gap between labor-intensive and costly ground-based vegetation sampling and less expensive but less precise satellite imagery
 - Develop cost effective techniques for measuring vegetation and other objects from digital images



Diagnostic Tools Approach

- **Image capture**
 - Scale
 - Lenses
 - Film type and developing
 - Scanning resolution
- **Software application and development**
 - Image processing (Rapid Assessment of Vegetation Structures – RAVS)
 - Geo-referencing and raster-to-polygon conversion





Diagnostic Tools Outcomes

- **Products:**
 - Technology transfer workshop and user's manual
 - Vegetation cover map
- **Applications:**
 - Change detection relative to soil types, landforms, and training loads
 - Change detection for entire installation for focusing rehabilitation efforts
 - Before/after to quantify the effect of individual rehabilitation projects
 - Foliar density for wind erosion modeling



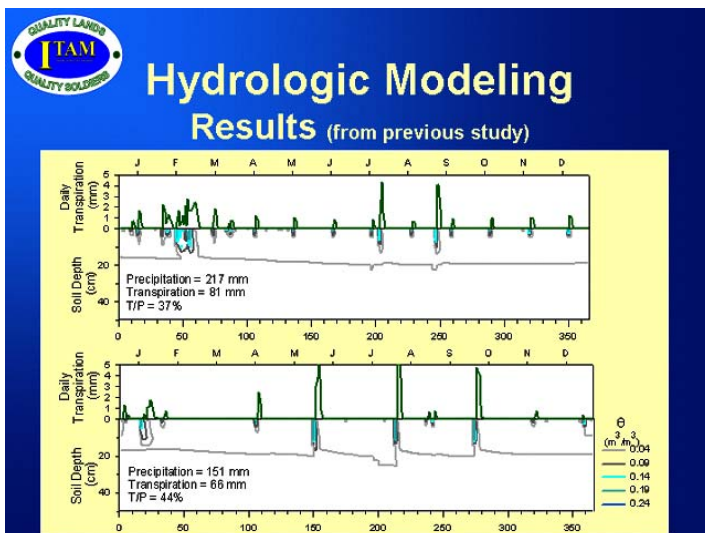
Current Research (3)

- HYDROLOGIC MODELING
- Desert Research Institute (Dr. Eric MacDonald)
- **Objectives:**
 - Compare key physical and hydrologic properties of different soils and surface treatments
 - Compare a numerical soil water balance model (SHAW) with field collected data on soil moisture
 - Interpret model results for typical precipitation patterns on the different soils and surface treatments



Hydrologic Modeling Approach

- Continuous tracking of temperature and soil moisture following precipitation or irrigation events in conjunction with an ongoing rehabilitation project
- Soil moisture probe locations
 - Two soil types
 - Three surface treatments (straw mulch, gravel mulch, bare)
 - Four depths
- Analysis
 - Use soil parameters to calibrate water balance model (SHAW)
 - Compare predicted soil moisture to field measurements
 - Relate soil moisture to plant responses



Hydrologic Modeling Outcomes

- **Product:**
 - Predictive model calibrated for major soil types
- **Applications:**
 - Effects of soil disturbance and surface treatments on hydrologic regime
 - Recommendations about optimal supplemental watering regimes for specific rehabilitation sites

Current Research (4)

- SEEDING TECHNOLOGIES
- SERDP - Bechtel-Nevada (Dr. Kent Ostler)
- **Objectives:**
 - Identify appropriate management actions for different levels of disturbance
 - Develop and refine seeding techniques, surface treatments, and irrigation strategies for soils and environmental conditions in the Mojave Desert

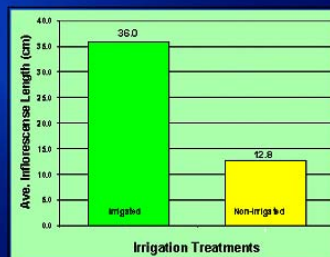
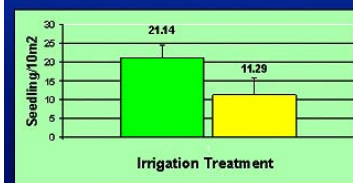


Seeding Technologies Approach

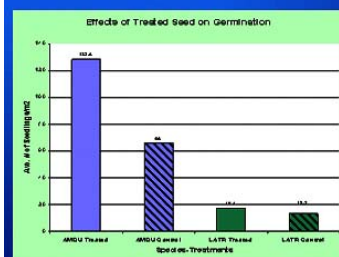
- FY00: Seeding with surface treatments and irrigation for different disturbance levels
 - Moderate – fertilizer, irrigation
 - Heavy – ripping, fertilizer, mulch, irrigation
 - Severe – ripping, fertilizer, mulch/tackifier, irrigation
- FY01: Improve germination and establishment of primary species
 - Germination trials with light, temperature, moisture, seed source
 - Field trials with pre-rinsing, soil temperatures, surface treatment
- FY02: Large-scale seeding



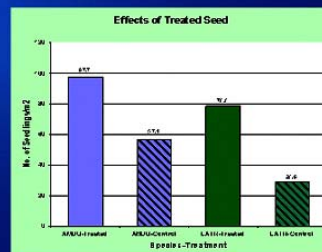
Seeding Technologies Results (FY00)



Seeding Technologies Results (FY01)



March seeding



April seeding



Seeding Technologies Outcomes

- Products:
 - Technology transfer workshops
 - Protocols for pre-treatment, seeding, and surface treatments
 - Costs of rehabilitation treatments
- Applications:
 - Implement spring seeding with pre-treated seed and short-duration irrigation
 - Use water balance model to determine appropriate irrigation strategies for different soil types
 - Consider interaction of surface treatment, soil temperature and species

Questions



5 Summary of Comments and Responses

During the workshop, each participant was asked to provide comments on specific projects, general direction of MCAGCC military demonstration, future direction and/or prioritization of future projects. This section summarizes the comments provided by the workshop participants. Table 1 lists each comment, who provided the comment, and the LMS response to the comment. Along with the response, the person responsible for addressing the issue is provided.

No.	Commenter	Comment/Question	Response
1	CERL	LUC model – when will it be available and if possible please provide to Jeff Fehmi for fulfillment of one of the original contracts that involved Dave Price (WES).	Answer: Will provide. (MCAGCC); LUC delivered to CERL in April 2002
2	MCAGCC	Scheduling fieldwork has been problematic, please give Rhys Evans a minimum of 10 days notice, any less will be ignored.	Will try to schedule fieldwork within the allotted MCAGCC time frame but due to weather constraints fieldwork scheduling may change on short notice. (CERL)
3	MCAGCC	MCAGCC POM cycle is 2003-2005. Any submissions of current projects, which have been appropriately revised to accommodate Class 1 Compliance perspectives, should be submitted by Jan 2003.	Noted. (CERL)
4	MCAGCC	MCAGCC wants to make sure that LMS projects are Class 1 Compliance driven.	The current projects funded by CERL were chosen by MCAGCC in 1998. With appropriate long term planning, MCAGCC should be able to integrate the end products into their compliance driven programs. (CERL)
5	Skidmore	Would like to put passive dust collectors within the PM monitoring sites at MCAGCC; so would Baldwin.	Request will be addressed by Otis-Diehl. (MCAGCC)
6	Skidmore / Baldwin	Asked for access to MCAGCC weather data.	Request will be addressed by Otis-Diehl. (MCAGCC). Access provided in April 2002.

Appendix A: MCAGCC LMS IPR Letter of Invitation and List of Invitees

CEERD-CN-C (70-1s)

31 December 2001

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: FY02 In-Progress Review (IPR) for Mojave Desert (Twentynine Palms) Land Management System (LMS) Military Field Application Site, 21 February 2002, Palm Springs, California

1. The second IPR for the Mojave Desert Marine Corps Air Ground Combat Center (MCAGCC) LMS Military Field Application Site will be held at the Holiday Inn - Palm Mountain Resort, 155 South Belardo, Palm Springs, CA. This IPR is designed to provide participants with an opportunity to learn about and influence the projects underway or planned for the Mojave Desert region and MCAGCC related to LMS. We will also be discussing how MCAGCC and other interested installations will use the outcomes of these projects.
2. There will be an opportunity during the IPR for MCAGCC and other interested installation personnel to provide feedback on specific projects, relate information on the general direction of the MCAGCC military demo, and input to prioritize future LMS (and related) projects at MCAGCC. Other participating organizations will also have the opportunity to contribute their input.
3. For additional information on LMS, see the enclosed brochure and review the LMS website at <http://www.denix.osd.mil/LMS>.
4. A block of rooms has been reserved at the Holiday Inn - Palm Mountain Resort, 155 South Belardo. Rooms must be reserved by 21 January 2002 to ensure availability. Rooms are \$89.00 plus tax, to make your reservations contact (800) 622-9451 or (760) 325-1301. You must mention that you are taking part in the *Twentynine Palms IPR* meeting to receive this special rate. Further information regarding local restaurants and attractions can be found at <http://www.palm-springs.org/> or <http://www.palmsprings.com>.

5. RSVP to Ms. Heidi Howard by Thursday, 14 February 2002 if you plan to attend this IPR. For questions concerning the IPR, please contact Ms. Heidi Howard at (217) 352-6511 ext. 7601, heidi.r.howard@erdc.usace.army.mil. Ms. Howard is helping coordinate the IPR and can assist you with any issues.

Encl

WILLIAM D. GORAN

LMS Coordinator

CEERD-CN-C (70-1s)

SUBJECT: FY02 In-Progress Review (IPR) for Mojave Desert (Twentynine Palms) Land Management System (LMS) Military Field Application Site, 21 February 2002, Palm Springs, California

DISTRIBUTION:

Lorrie Agnew
Anak Agung
Alan Anderson
Christopher Baldwin
Pat Black
Kelly Dilks
Rhys Evans
Clarence Everly
Jeff Fehmi
Jeff Foisy
Patrick Fowler
Tom Frank
Dick Gebhart
William Goran
Russell Harmon
Steve Hodapp
Robert Holtz
Heidi Howard
Wayne Johnson
Bruce Jones
Randy Karalus
Liz Kellogg
Robert Koenigs
Richard Lawrence
Dawn Lawson
Roy Madden
Valerie Morrill
Dave Mouat
Jim Omans
Kip Otis-Diehl
Rob Palmer
Doug Ramsey
Ed Skidmore
Ruth Sparks
Paul Tueller
Scott Tweddale
Robert Washington-Allen
Lucy Whalley

CEERD-CN-C (70-1s)

SUBJECT: FY00 In-Progress Review (IPR) for Mojave Desert (Twentynine Palms) Land Management System (LMS) Military Field Application Site, Thursday, February 21, 2002, Palm Springs, California

TENTATIVE AGENDA

0800 IPR Opens at Holiday Inn Palm Mountain Resort

0815-0845 Overview LMS Introduction, Bill Goran

0845-0915 MCAGCC/LMS Overview, Dr. Gebhart

0915-1015 ATTACC, Mr. Anderson

1015-1030 Break

1030-1130 Wind Erosion, Ed Skidmore

1130-1200 Ecological Dynamics Modeling, Dr. Fehmi

1200-1300 Lunch Break

1300-1330 Catastrophic Erosion Events and Nutrient Dynamics, Dr. Baldwin

1330-1415 TBA

1415-1500 TBA

1500-1545 Change Detection/Remote Sensing at MCAGCC, Mr. Tweddale

1545-1600 Break

1500-1600 Comment and Review

1600-1645 Input from other participating organizations IPR conclusion.

Appendix B: MCAGCC LMS IPR List of Attendees Information

NAME	ORGANIZATION	ADDRESS	PHONE and EMAIL
Chris Baldwin	Sam Houston State University	SHSU Dept GEO/GEO Box 2148 Huntsville, TX 77341-2148	(936) 294-1593 baldwin@shsu.edu
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ATTN: Cold Regions Research, Hanover, NH
ATTN: Topographic Engineering Center, Alexandria, VA

Defense Tech Info Center 22304
ATTN: DTIC-O

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14. ABSTRACT The Land Management System (LMS) is an initiative of the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) focused on improving landscape analysis and landscape management capabilities in several of the Corps of Engineers' major mission areas. The LMS provides relevant science, tools, and information to land and water resource managers and decisionmakers with the goal of enhancing their ability to understand and communicate past, current, and potential impacts of management actions on land and water resources. In 1999, the Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms, CA, was officially designated as a field application site. Field Application Site In-Progress Reviews (IPRs) are designed to ensure that the stages of evaluation, modification, and documentation are fulfilled. This document presents information from the second IPR workshop held 21 February 2002. The IPR consisted of presentations on LMS and individual projects. Following project presentations, inputs from installation personnel and others present were obtained. Prior to the meeting closure, user input was discussed and actions were defined to address each issue. Results of the IPR are documented in this report to ensure project improvements and adjustments occur and to assist with the next IPR.					
15. SUBJECT TERMS Marine Corps Air Ground Combat Center (MCAGCC) modeling and simulation land management Land Management System (LMS) integrated software water management					
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